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MINERAL RESOURCES

OF THE

UNITED STATES

1924

FRANK J. KATZ
Chief Engineer, Division of Mineral Resources and Statistics

PART I—METALS

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MINERAL RESOURCES OF THE UNITED STATES, 1924—PART I

THE MINERAL RESOURCES OF THE UNITED STATES IN 1924[1]

INTRODUCTION

By Frank J. Katz
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In 1924 mining and quarrying kept pace with other industries in receding from the high rate of production shown in 1923. As there were no great strikes or other markedly disturbing conditions, as transportation facilities were adequate, and as there had been ample time for adjustment to the tariff of 1922, it is probable that the statistics for 1924 may measure a normal year's output except for those products, chiefly soft coal, iron ore, and sulphur, of which large stocks were carried over from the year before.

The total value of mineral products of the United States in 1924 was $5,305,800,000, compared with $5,986,500,000 in 1923, a decrease of 11 per cent. Although price levels changed little from 1923 to 1924, there was a general downward tendency accentuated by a considerable drop in the average value of two bulky items in the mineral list, iron ore and coal. It is certain, therefore, that the aggregate volume of mineral output decreased less than 11 per cent. The total value for 1924 was 14 per cent above that for 1922 and 28 per cent above that for 1921, but 24 per cent less than that for 1920, when prices were at their highest.

In 1924 the bituminous coal mining industry failed to maintain its record of 1923 for steady production and large output. The industry faced a diminished market, due in part to slackening of the general industrial pace; in part to appreciable inroads by other sources of energy, chiefly oil and gas; to some extent to the effect of improved economy in the use of coal, which is gradually making itself felt; but chiefly, no doubt, to the fact that consumers, feeling secure from strikes, drew heavily upon their stocks. In 1923 some 26,000,000 tons had flowed into storage. In 1924 millions of tons flowed out of storage—just how much is not known, but probably

[1] In Mineral Resources of the United States the use of leaders (------) indicates that so far as the Bureau of Mines has been able to ascertain there was nothing to report. If data are not available, the fact is indicated by a statement to that effect in a footnote. Leaders are also used in footings where it is quite evident that figures in a column are not addable and in other places where entries are not appropriate.

All figures of imports and exports in this report were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce, having been converted by Mr. Dorsey to the various units of measurement used in this report and arranged by him in their present form. The imports are those for the calendar year unless otherwise stated. Wherever exports are shown, unless otherwise specified, the figures represent domestic products and not foreign minerals reexported, and they also cover calendar years.

16,000,000 tons was withdrawn during the year. The state of the market was reflected in a marked reduction of prices. No element of the industry entirely escaped the effect of these conditions, which, however, rested unequally upon individual mines and districts. The general result was to quicken the pace and heighten the effect of a change in the industry that has made notable progress since the end of the temporary boom after the great strike of 1922. This change is a shift in production from "high cost" to "low cost" mines and from union to nonunion districts, with a corresponding shift in the geographic distribution of production. This movement was marked late in 1923 but became pronounced immediately after the signing of the Jacksonville wage agreement in February, 1924, when buying for storage in anticipation of a strike subsided.

Comparison with 1923 does not show the full results of the conditions prevailing in 1924, because the shifting was well under way in the latest months of 1923. Nor would 1922 or 1921, both abnormal years, serve for comparison. In 1920, on the other hand, all districts worked under favorable market conditions and the present level of union wage rates was set. In comparison with 1920, 1924 shows that on the average, for the industry as a whole, production fell 15 per cent short but that in the strong union States, Illinois, Indiana, Ohio, Iowa, Oklahoma, and Michigan, without exception, it fell over 10 to 30 points more than the average. In sharp contrast the nonunion States, Kentucky, West Virginia, Alabama, and Virginia, did better in 1924 than the average of all States, and the first three much better than in 1920. It is noteworthy that Pennsylvania which includes both union and nonunion territory, produced 77 per cent as much in 1924 as in 1920, whereas West Virginia produced 113 per cent and came within less than 29,000,000 tons of surpassing Pennsylvania and taking first place among the soft coal producing States.

The total output of soft coal for the year was 483,687,000 short tons, a decrease of 80,878,000 tons from the total for 1923. The quantity is about 11 per cent more than the average for the three years of depression, 1919, 1921, and 1922, and 15 per cent less than the average for the active years 1918, 1920, and 1923.

The value of all soft coal produced in 1924 was $1,062,626,000, and the average value per ton was $2.20, a decrease of 48 cents as compared with 1923. The Coal Age index shows that the average spot price for the year was $2.08, as compared with $2.77 in 1923.

The anthracite industry during 1924 was in the main without disturbing influences other than "outlaw strikes." Despite the effect of such strikes, the total output was 78,500,000 long tons, as against 83,338,000 long tons in 1923, when an extraordinary demand created by the shortage due to the strike of 1922 drove production almost to the peak attained in war years.

In step with the slackened pace in the iron and steel industry and in the absence of unusual demand for coke as household fuel, the production of coke fell off to 44,270,000 short tons, which was less than the output in any recent years except those of severe depression, 1919, 1921, and 1922. The decrease was much more marked in the production of beehive coke, which was only about half as great as in 1923, than in that of by-product coke, which declined 10 per cent. The by-product ovens contributed 77 per cent of the total coke-oven

output, and the beehive ovens 23 per cent. The beehive-coke industry is being fast relegated to the position of an auxiliary source of supply, called upon when the output of the by-product ovens is not sufficient to meet the demand. Five new by-product plants started production in 1924, and a number of new ovens were added to existing plants. The year's production of by-product coke was 33,984,000 short tons, which has been exceeded only once, in 1923, and that of beehive coke was 10,286,000 short tons, less than in any other year since the financial depression of 1893 and 1894, except 1921 and 1922.

In 1924 the production of petroleum in the United States amounted to 713,940,000 barrels, which is 2.5 per cent less than that in 1923 and is the first annual decrease in production since 1906. The decline is chiefly due to the decrease of 13 per cent in the California output from the record high yield in 1923. Smaller declines are also recorded in all the other major fields excepting the Mid-Continent. In the Mid-Continent field, which produces more than half of the output of the entire country, an increase of almost 8 per cent over the 1923 output is recorded. California again led all other States in the production of petroleum with an output of 228,933,000 barrels. Oklahoma ranked second, with a production of 173,538,000 barrels, and Texas third, with 134,522,000 barrels. The output of these three States in 1924 was more than 75 per cent of the production of petroleum in the entire country. In 1924 the output of heavy oil, heavier than 24° A. P. I. (0.910), increased to 24 per cent of the total production of the United States; in 1923 it amounted to 18 per cent of the total.

In California decreased production of the three large pools in the Los Angeles Basin, together with the smaller decrease of the older pools, in spite of the development of the Dominguez pool and the increased output of Torrance and of some of the pools in San Joaquin Valley and elsewhere in which wells had been shut down in 1923, resulted in the loss of about 34,000,000 barrels. In Wyoming decreased output of the Salt Creek pool is recorded. The peak production for this pool, for which an increasing output has been recorded since 1912, was attained in January, 1924, when a daily average production for the month of more than 113,000 barrels was recorded. After January the output of the Salt Creek pool steadily declined, and in December the daily average was reduced to less than 50,000 barrels. Many wells in this pool have been idle since they ceased to flow, awaiting the construction of a large electric-power plant for use in pumping. Recent discovery of oil in deeper sands will tend to check the decline of the Salt Creek pool. In Louisiana development of the new Cotton Valley and Lockport pools was insufficient to overcome the decline of the older pools, and the net loss for the State was nearly 4,000,000 barrels. In Oklahoma increased output resulted from flush production in the Cromwell, Papoose, and Stroud pools and from a deeper sand at Tonkawa. In Arkansas the Smackover pool is chiefly responsible for the recorded increase of 9,400,000 barrels. In Texas the pools in the fault zone east of the Balcones escarpment, Powell, Richland, Mexia, Luling and Wortham, are to be chiefly credited for the sustained output. The Wortham pool, discovered late in November and 51 days later yielding a daily output of 167,000 barrels, is the most quickly devel-

oped pool on record. Other new oil pools developed during 1924 are the Rainbow Bend, in Kansas; the Moffat and Fort Collins in Colorado; the Big Lake, in Montana; the Rattlesnake and Hogback, in New Mexico; and the Rex Lake, in Wyoming.

One of the noteworthy developments of the year was the application of the seismograph and the torsion balance to the discovery of salt domes, three of which in the Gulf coast field of Texas, as reported, have already been found by these instruments.

Imports into the United States in 1924 of almost 78,000,000 barrels of crude oil, equal to 11 per cent of the domestic production, were 4,000,000 barrels less than in 1923 but contrast with imports of 127,000,000 barrels in 1922, which were equivalent to 23 per cent of the domestic production for that year. As in previous years, the great bulk of imports came from Mexico and the decreased quantity followed the decreased production of that country. Increasing quantities of petroleum were imported from Peru and Venezuela. Exports of crude oil increased slightly and amounted to almost 18,000,000 barrels.

The demand for crude petroleum continued to grow in 1924, but at a lower rate contrasted with the increase in 1923 and 1922, and, as in the past few years, the demand was somewhat less than the new supply. The total indicated domestic consumption in 1924 was 748,462,000 barrels; 643,719,000 barrels of this was run to refinery stills, and the remainder was consumed as fuel.

The excess of supply over the demand resulted in an increase of 25,280,000 barrels in stocks of crude petroleum. Total stocks including crude at refineries, on December 31, 1924, were 399,792,000 barrels. In addition 85,611,000 barrels of liquid refined products were held at refineries as contrasted with 77,455,000 barrels on the last day of 1923.

Continued low prices reflected this oversupply, which has been pronounced since 1920. The average price per barrel at the wells was $1.43 in 1924, as contrasted with $1.34 in 1923 and $3.07 in 1920. The total value at the wells of the Nation's crude petroleum output, $1,022,683,000, has been exceeded only once in the history of the industry, in 1920, when the total value of a much smaller output was $1,360,745,000.

During the year 21,888 wells were drilled for oil and gas in the United States; 14,587 were oil wells and the remainder gas wells or dry holes. On December 31, 1924, there were 299,100 producing oil wells in the United States and the average daily production per well was 6.2 barrels.

In 1924 the production of gold again showed only a very slight increase over that for the preceding year, as costs of mining and general price levels had not changed sufficiently to give an appreciable stimulus to the industry, which has long been stagnant. The output was $52,277,000, an increase of $543,000 over that of 1923. In contrast to the record in preceding years, however, the output was not sustained wholly by increases in the output recovered from base-metal ores containing gold. Gold from Colorado, one of the States producing gold chiefly from siliceous ore and placers, showed so large an increase as to overcome losses in other States.

The production of silver in 1924 was 65,407,000 ounces, valued at $43,823,000, a decrease of 11 per cent in quantity and of 27 per cent

in value from corresponding figures for 1923. Decrease was the rule throughout the mining States; New Mexico and Idaho showed gains in quantity but losses in value. The decline was due in part to lower prices for the metal, which averaged $0.67 in 1924 as against $0.82 in 1923. The average price for 1924 was nevertheless 2 cents higher than the price during the second half of 1923, after the cessation of purchases under the Pittman Act.

In 1924 the production and consumption of copper exceeded with substantial margins the new peace-time records which had been established in 1923. Smelter production and withdrawals on domestic account in 1924 have been surpassed only in 1916, 1917, and 1918 and the refined production from domestic and foreign sources only in 1917 and 1918. Consumption was at a somewhat higher rate than production in 1924, and stocks of both refined and blister copper were decreased. Total imports of unmanufactured copper, 769,000,000 pounds, were the highest ever recorded and were 92,000,000 pounds higher than those in 1923, the previous high year. The year 1917, when 1,126,000,000 pounds of metallic copper was exported, is the only year which has showed higher exports than those in 1924, when 1,117,000,000 pounds was exported. Europe was taking increasing quantities of copper, despite unsatisfactory political conditions in several of the countries. Consumption per capita in European countries, however, was far below that in the United States, where consumption was admittedly on a satisfactory level. During the postwar years, when copper producers have had to dispose of their product at prices considerably below the scale of prices for other commodities, a large percentage of the producers have made records in the efficient management of their mines and in low-cost production which would probably have never been attained if prices had compared more favorably with those for other materials. Those companies which have been successful in building efficient organizations because of the necessity of producing copper at the lowest possible cost can now obtain profits on a much lower price for copper than has heretofore been possible. Other formerly successful companies are still unable to cope with present conditions.

The quoted price of prime western zinc at the beginning of the year in the St. Louis market was 6.275 cents, but it rose to 6.925 cents by the middle of February and then declined gently to 5.65 cents by the latter part of May. A very gradual rise, becoming more pronounced in the last quarter, carried the price to 7.825 cents at the end of the year. The average quoted price a pound for prime western zinc for immediate delivery at St. Louis in 1924 was 6.3 cents, as compared with 6.7 cents in 1923 and with 5.7 cents in 1922.

A canvass of the sales of zinc and the amounts received by producers in 1924 gives 6.5 cents a pound as the average selling price of all grades. This is the figure used in calculating the value of the zinc output of the country. The industry was active, however, but in varied degree according as the price changed, and the year closed with smelter stocks of metal less than at any time in the preceding 18 months. An increase of 4 per cent was made in the mine production of zinc, but the smelter output of slab zinc was practically the same as in 1923. The mines of the Eastern States made a gain of 7 per cent, and those of the Central States also 7 per cent, but those of the

Western States fell off slightly in output. The largest actual increase in mine output was made by the Joplin region, which again produced about 60 per cent of the country's mine output of zinc. Oklahoma gained 11 per cent and had a larger output than any other State, mining 42 per cent and smelting 23 per cent of the entire country's zinc output. The exports of metallic zinc increased nearly 45 per cent. The sales of zinc pigments increased, and the price was better. The sales of zinc chloride and lithopone also showed good increases, although the prices were not so high as in 1923.

In 1924, as in 1923, the price of lead was marked by great fluctuations. The quoted price for prompt delivery in the New York market rose from 8.3 cents a pound at the beginning of the year to 9.87 cents the last of February, and then declined to 7 cents in June. A decided upward trend through the remainder of the year culminated in a quotation of 10.2 cents at the end of December. The average quoted price for the year was 8.3 cents, compared with 7.4 cents in 1923. Such fluctuations unsettled both the producing and the consuming ends of the industry and tended to discourage the opening of new sources of supply and to prevent development. These fluctuations seemed to be due to extraneous conditions not inherent in the industry. The average selling price, based on total sales, was 8 cents a pound in 1924, compared with 7 cents in 1923, and this is the figure used in calculating the value of the lead output of the country. In spite of fluctuations the general advance in price brought about an increase of 9 per cent in the mine production of lead and of 12 per cent in the quantity smelted and refined in the United States. The same cause was influential in bringing about the increase of 67 per cent in the quantity of foreign lead smelted and refined in the country. The leading States in mine production of lead in 1924 were Missouri, Idaho, Utah, and Oklahoma. The exports of foreign lead from bonded warehouse increased nearly 60 per cent. The year closed with more than 100,000 tons of foreign lead in bonded warehouse in pigs, bullion, ore, and matte. The sales of sublimed lead showed a gain of nearly 25 per cent at virtually the same price as in 1923, and the sales of white lead made a gain of 15 per cent in quantity and 28 per cent in total value. Sales of colored lead pigments, red lead, orange mineral, and litharge, all decreased.

The year 1924 was marked by a sharp decline in the iron and steel industry and also by the opening on a commercial basis of a new group of iron mines and a steel plant in Utah. The production of ore in the country as a whole was about one-fifth less than in 1923, and the ore shipped from mines was one-fourth less. The average value at the mines of ores shipped was $2.91, a drop of $0.54 from the average for 1923. The decline in ore movement may be ascribed in part to a slowing up in demand for steel and a general reaction in pig-iron manufacture during the middle of 1924 following the record year 1923, in which there was some overproduction. The shipments of pig iron decreased from 38,361,000 long tons in 1923 to 31,064,000 tons in 1924.

The shipments of manganese ore containing 35 per cent or more of manganese in 1924 were largely increased over those in 1923, which in turn were considerably in advance of those in 1922. These increases have been due to the tariff on manganese, which has en-

abled some operators to produce ore at a profit. The number of shippers of the higher grades of ore also increased in 1924. One of the outstanding events of the year was the bringing into operation of the new manganese deposit at Port Angeles, Wash. In 1924 the only notable quantity of manganese ore ever shipped from Washington went from this deposit and consisted of 5,000 long tons of ore containing approximately 53 per cent of manganese. In 1924 the manganese content of ore imported for consumption was approximately 224,230 long tons, valued at $5,305,791. On the assumption that the manganese content of the ore imported was approximately 48 to 50 per cent, the imports of ore would be approximately twice the figures of content given.

Antimony attracted considerable attention in the metal markets in 1924 on account of fluctuations in price brought about by political conditions in China, which is the world's chief source of supply. The price rose with demand early in the year and then declined until midyear, after which it rose steadily as stocks diminished and at the end of the year was the highest since the flurry that followed the entrance of the United States into the World War. The output in the United States in 1924 consisted practically altogether of antimonial lead, of which nearly 50 per cent more was produced than in 1923.

The production and sales of arsenic in 1924 broke all previous records. The companies that produced white arsenic in the United States reported sales of crude and refined amounting to nearly 14,500 short tons, or 72 per cent of the total white arsenic produced. Imports were large and second only to those of the year before. Supplies were ample, and prices declined during the year. According to New York journals prices for white arsenic at the end of the year were about one-half of the January price of 13½ cents a pound. Domestic producers received about 9 cents a pound on the average for the year's sales of all products. During 1924 nearly two-thirds of the total refined and crude arsenic was obtained from ore roasted primarily for its arsenic content; one-third was a by-product of copper and lead reduction works.

The total value of nonmetallic mineral products, other than fuels, was slightly increased over 1923, but in the main the output of the several commodities showed little change. The output of the structural materials cement, gypsum, and sand and gravel increased 8, 6, and 12 per cent, respectively, but stone and lime were produced in about the same amounts as in the year before. The salines and fluorspar, which are used principally in chemical and metallurgical work, were produced in slightly larger quantities in 1924 than in 1923, but the production of refractories and the sales of sulphur and pyrites, the sources of the master chemical sulphuric acid, showed decreases. Of the fertilizer ingredients phosphate rock and potash, of which there was a much larger production in 1923 than in 1922, potash increased 13 per cent in 1924 but phosphate rock decreased 3 per cent. The output of the ceramic materials clay, feldspar, and silica was larger in 1924 than in 1923. The total value of mineral abrasive materials sold was not quite as great as in 1923.

SUMMARY

By MARTHA B. CLARK

GENERAL TABLES

Mineral products of the United States in 1923 and 1924[a]

Product	1923		1924	
	Quantity	Value	Quantity	Value
METALLIC				
Aluminum ..... pounds	----------	$28,305,000	----------	$37,607,000
Antimonial lead [b] ..... short tons (2,000 pounds)	14,190	1,950,370	20,787	3,376,713
Antimony [c] ..... do	2,170	[c] 338,500	2,763	[c] 596,800
Bauxite ..... long tons (2,240 pounds)	522,690	3,156,610	347,570	2,137,990
Cadmium ..... pounds	183,816	161,758	129,328	77,597
Chromite ..... long tons	227	3,819	288	1,140
Copper, [d] sales value ..... pounds	1,434,999,962	210,945,000	1,634,249,192	214,087,000
Ferroalloys ..... long tons	579,817	49,877,231	497,244	43,249,948
Gold [e] ..... troy ounces	2,502,632	51,734,000	2,528,900	52,277,000
Iron:				
Ore [f] ..... long tons	69,811,472	[f] 240,738,921	52,083,375	[f] 151,307,105
Pig ..... do	38,361,379	946,799,378	31,064,129	665,078,972
Lead (refined), [d] sales value ..... short tons	543,841	76,138,000	566,407	90,625,000
Manganese ore (35 per cent or more Mn) [g] ..... long tons	32,269	880,178	58,348	1,318,771
Manganiferous ore (5 to 35 per cent Mn) [g] ..... do	1,433,897	4,888,393	898,468	2,739,254
Nickel (value at New York City) ..... short tons	100	71,605	191	114,903
Ores (crude), tailings, etc.:				
Copper ..... do	45,573,000	(h)	49,432,000	(h)
Copper-lead and copper-lead-zinc ..... do	162,000	(h)	220,000	(h)
Dry and siliceous (gold and silver) ..... do	9,122,000	(h)	8,979,000	(h)
Lead ..... do	7,613,000	(h)	8,569,000	(h)
Lead-zinc ..... do	10,987,000	(h)	13,356,000	(h)
Zinc ..... do	4,064,000	(h)	3,160,000	(h)
Platinum and allied metals (value at New York City) ..... troy ounces	49,797	5,762,305	66,007	7,611,319
Quicksilver (value at San Francisco) ..... flasks (75 pounds net)	7,937	521,302	10,061	691,090
Quicksilver ore ..... short tons	51,000	(h)	70,000	(h)
Silver ..... troy ounces	73,335,170	60,134,839	65,407,186	43,822,814
Tin (metallic equivalent) ..... short tons	2	1,623	7	7,028
Titanium ore:				
Ilmenite ..... do	6,270	(i)	4,769	(i)
Rutile ..... do	270	(i)	----------	----------
Tungsten ore (60 per cent concentrates) ..... do	241	144,600	565	287,000
Uranium and vanadium ores ..... do	2,025	150,000	(i)	(i)
Zinc, [d] sales value ..... do	508,335	69,134,000	515,831	67,058,000
Total value of metallic products (approximate)	----------	1,510,930,000	----------	1,232,330,000

NONMETALLIC

Arsenious oxide	short tons	14,271	2,808,801	14,453	2,655,015
Asbestos	do	227	9,626	300	42,526
Asphalt:					
Native	do	400,236	2,885,631	562,367	3,958,339
Oil [f]	do	995,654	[f] 13,060,174	1,158,456	[f] 14,305,007
Barytes (crude)	do	214,183	1,664,156	196,332	1,540,744
Borates (colemanite and naturally occurring borax)	do	136,650	3,994,790	116,110	3,183,910
Bromine	pounds	842,352	146,176	2,033,804	594,685
Calcium-magnesium chloride	short tons	44,961	663,384	58,791	1,164,848
Cement	barrels (376 pounds net)	137,183,792	259,631,776	147,466,010	266,053,267
Clay:					
Products			[i] 424,582,628		[i] 415,779,378
Raw [f]	short tons	3,434,660	[f] 11,188,913	3,691,119	[f] 11,507,536
Coal:					
Bituminous [k]	do	564,564,662	1,514,621,000	483,686,538	1,062,626,000
Pennsylvania anthracite	long tons	83,338,401	506,786,768	78,506,127	477,230,852
Coke [f]	short tons	56,977,534	[f] 373,496,898	44,269,605	[f] 244,041,561
Diatomaceous (infusorial) earth and tripoli	do	92,915	1,082,163	91,639	1,083,326
Emery	do	2,286	29,478	2,195	19,756
Feldspar (crude)	long tons	145,004	1,057,595	204,772	1,509,339
Fluorspar	short tons	121,188	2,505,819	124,979	2,451,131
Fuller's earth	do	149,134	2,247,523	177,994	2,632,342
Garnet for abrasive purposes	do	9,006	688,437	8,290	674,176
Gems and precious stones			65,000		[l]
Graphite:					
Amorphous	short tons	4,056	39,560	4,071	38,533
Crystalline	pounds	3,964,900	151,434	1,890,325	48,977
Grindstones and pulpstones	short tons	46,570	1,689,315	38,184	1,666,669
Gypsum	do	4,753,448	34,888,155	5,042,629	42,724,507
Lime	do	4,076,243	39,993,652	4,072,000	39,596,423
Magnesite (crude)	do	147,250	1,103,700	120,100	1,041,300
Mica:					
Scrap	do	8,054	129,695	4,709	87,242
Sheet	pounds	2,063,179	311,180	1,460,897	212,035
Millstones			22,229		30,125

[a] In this general statement certain of the figures represent shipments rather than quantity mined. The reader is referred to the following sections on the various mineral products for information in greater detail than it seems practicable to give here.
[b] From both domestic and foreign ores.
[c] Content of antimonial lead. None from other sources. Values excluded from metallic totals as the values of the antimony are included in the antimonial lead values.
[d] Product from domestic ores only.
[e] Value, $20.671834625323 an ounce.
[f] Value not included in total value.
[g] Including ore used for fluxing. For separation see p. 56A.
[h] Figures showing values not available.
[i] Value included in total value of metallic products. Bureau of Mines not at liberty to publish figures.
[j] Figures obtained through cooperation with Bureau of the Census.
[k] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.
[l] Canvass discontinued after 1923. No canvass for 1924. Estimate of value included in total value of nonmetallic products.

Mineral products of the United States in 1923 and 1924—Continued

Product		1923		1924	
		Quantity	Value	Quantity	Value
NONMETALLIC—continued					
Mineral paints:					
Natural pigments [m]	short tons	[m]	[m]	[m]	[m]
Zinc and lead pigments [n]	do	163,240	$23,660,381	173,859	$25,711,159
Mineral waters	gallons sold	44,430,998	6,493,177	[l]	[l]
Natural gas	M cubic feet	[o] 1,006,976,000	[o] 240,001,000	1,141,521,000	253,856,000
Natural-gas gasoline	gallons	816,226,000	77,268,000	933,861,000	82,233,000
Oilstones, etc	short tons	1,223	231,812	1,056	258,943
Peat	do	61,355	376,834	55,469	395,470
Petroleum	barrels (42 gallons)	732,407,000	978,430,000	713,940,000	1,022,683,000
Phosphate rock	long tons	3,006,706	11,576,049	2,867,789	10,252,083
Potash (K_2O)	short tons	19,281	784,671	21,880	842,618
Pumice	do	56,575	214,169	43,651	190,253
Pyrites	long tons	181,628	661,000	160,096	645,262
Salt	short tons	7,130,713	27,795,941	6,803,115	25,747,048
Sand:					
Glass	do	2,034,958	3,751,778	2,169,899	3,718,973
Molding, building, etc., and gravel	do	137,897,195	87,151,876	154,060,164	93,294,142
Sand-lime brick	thousands	[i] 213,425	[i] 2,471,536	[i] 283,417	[i] 3,334,503
Silica (quartz)	short tons	20,601	193,630	23,761	203,177
Slate	do	[o] 707,100	12,076,624	727,709	11,776,016
Stone	do	[o] 103,318,660	[o] 159,470,241	103,184,120	161,870,113
Sulphur	long tons	1,618,841	26,000,000	1,537,345	25,000,000
Sulphuric acid (60° Baumé) from copper and zinc smelters	short tons	[p] 785,789	[p] 6,209,157	874,953	6,996,000
Talc and soapstone	do	196,692	3,012,253	203,821	3,515,556
Total value of nonmetallic products (approximate)			4,471,620,000		4,067,730,000
SUMMARY					
Total value of metallic products			1,510,930,000		1,232,330,000
Total value of nonmetallic products (exclusive of mineral fuels)			1,154,520,000		1,169,100,000
Total value of mineral fuels			3,317,100,000		2,898,630,000
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated) [q]			3,950,000		[q] 5,740,000
Grand total approximate value of mineral products			5,986,500,000		5,305,800,000

[i] Figures obtained through cooperation with Bureau of the Census.
[l] Canvass discontinued after 1923. No canvass for 1924. Estimate of value included in total value of nonmetallic products.
[m] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").
[n] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.
[o] Revised figures.
[p] According to the Bureau of the Census.
[q] Includes in 1924 the value of bismuth, cadmium sulphide and other cadmium compounds, chats ($391,100), columbite ($598), flint lining for tube mills, iron ore sold for magnets, iron ore sold for paint ($103,626), lithium minerals ($62,391), natural magnesium chloride, natural magnesium sulphate ($293,167), calcareous marl ($225,383), greensand marl ($151,205), mineral soap, molybdenum, pebbles for grinding, selenium ($286,066), silica sand and sandstone (finely ground) ($1,464,948), sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources ($1,009,770), tellurium, zircon ($39,340), and an estimate of the value of miscellaneous mineral products, statistics for which are not collected annually by the Bureau of Mines.

Total value of mineral products of the United States, 1880–1924

Year	Metallic		Nonmetallic		Unspecified (metallic and nonmetallic)	Total	
	Value	Percentage of increase or decrease	Value	Percentage of increase or decrease		Value	Percentage of increase or decrease
1880–1913 [a]	$14, 592, 140, 000		$20, 647, 894, 000		$55, 866, 000	$35, 295, 900, 000	
1914	686, 639, 000	−22	1, 424, 063, 000	−8	470, 000	2, 111, 172, 000	−13
1915	991, 730, 000	+44	1, 400, 484, 000	−2	2, 430, 000	2, 394, 644, 000	+13
1916	1, 620, 745, 000	+63	1, 884, 413, 000	+35	3, 281, 000	3, 508, 439, 000	+47
1917	2, 086, 234, 000	+29	2, 900, 462, 000	+54	5, 800, 000	4, 992, 496, 000	+42
1918	2, 153, 318, 000	+3	3, 380, 690, 000	+17	6, 700, 000	5, 540, 708, 000	+11
1919	1, 359, 744, 000	−37	3, 232, 626, 000	−4	3, 400, 000	4, 595, 770, 000	−17
1920	1, 762, 350, 000	+30	5, 214, 170, 000	+61	4, 820, 000	6, 981, 340, 000	+52
1921	654, 130, 000	−63	3, 481, 720, 000	−33	2, 650, 000	4, 138, 500, 000	−41
1922	987, 180, 000	+51	3, 656, 410, 000	+5	3, 700, 000	4, 647, 290, 000	+12
1923	1, 510. 930, 000	+53	4, 471, 620, 000	+22	3, 950, 000	5, 986, 500, 000	+29
1924	1, 232, 330, 000	−18	4, 067, 730, 000	−9	5, 740, 000	5, 305, 800, 000	−11
Grand total	29, 637, 470, 000		55, 762, 282, 000		98, 807, 000	85, 498, 559, 000	

[a] For totals by years prior to 1914 see Mineral Resources, 1920.

Value of mineral products of the United States, 1920–1924, by States [a]

State	1920	1921	1922	1923	1924
Alabama	$86, 289, 575	$52, 269, 451	$61, 723, 268	$82, 496, 430	$77, 315, 758
Alaska	23, 396, 114	17, 041, 057	19, 506, 610	20, 241, 137	17, 361, 834
Arizona	116, 383, 335	30, 818, 363	63, 737, 720	104, 940, 213	100, 325, 413
Arkansas	17, 813, 328	22, 515, 412	31, 418, 633	41, 954, 319	61, 748, 999
California	269, 404, 686	297, 025, 679	283, 411, 997	375, 492, 868	428, 175, 652
Colorado	76, 037, 896	54, 045, 056	54, 806, 277	61, 379, 146	61, 487, 882
Connecticut	6, 326, 326	4, 219, 457	5, 346, 295	7, 177, 266	8, 129, 332
Delaware	359, 833	379, 785	428, 314	416, 074	512, 105
District of Columbia	369, 534	411, 745	869, 132	929, 768	813, 608
Florida	22, 923, 780	12, 597, 948	10, 907, 718	12, 557, 822	13, 101, 223
Georgia	12, 178, 695	8, 650, 003	11, 120, 018	14, 300, 313	14, 946, 610
Idaho	32, 449, 783	16, 502, 273	18, 495, 628	27, 105, 344	27, 831, 623
Illinois	373, 926, 540	254, 019, 136	244, 617, 561	282, 760, 623	235, 796, 027
Indiana	146, 736, 294	97, 700, 676	108, 394, 095	130, 885, 954	112, 299, 075
Iowa	57, 250, 480	35, 639, 505	36, 205, 251	46, 174, 897	40, 459, 869
Kansas	198, 097, 758	113, 098, 346	103, 884, 561	110, 630, 255	105, 005, 476
Kentucky	195, 920, 036	114, 404, 662	158, 701, 496	148, 853, 786	120, 510, 775
Louisiana	138, 745, 725	61, 061, 974	75, 519, 328	61, 199, 048	56, 930, 681
Maine	5, 428, 086	4, 392, 039	5, 588, 140	7, 565, 553	6, 035, 160
Maryland	30, 944, 378	16, 083, 965	14, 905, 227	21, 189, 542	18, 506, 867
Massachusetts	12, 411, 708	9, 835, 107	11, 004, 523	14, 781, 129	15, 725, 882
Michigan	166, 338, 818	69, 452, 819	101, 430, 981	128, 291, 450	114, 239, 386
Minnesota	177, 589, 967	72, 609, 973	111, 617, 448	174, 105, 328	107, 844, 680
Mississippi	2, 201, 246	1, 954, 353	1, 600, 393	2, 163, 343	2, 090, 422
Missouri	90, 994, 479	56, 375, 543	62, 402, 642	79, 201, 473	81, 054, 122
Montana	85, 885, 403	30, 161, 734	59, 400, 591	74, 707, 269	70, 631, 806
Nebraska	7, 168, 424	2, 366, 287	2, 996, 587	3, 302, 397	3, 209, 425
Nevada	25, 648, 961	14, 038, 071	18, 374, 023	28, 598, 627	26, 225, 943
New Hampshire	2, 986, 485	2, 234, 007	2, 283, 119	3, 572, 615	3, 378, 165
New Jersey	72, 335, 207	47, 429, 290	62, 396, 379	72, 602, 066	75, 271, 009
New Mexico	27, 883, 565	13, 227, 268	18, 038, 022	23, 791, 047	23, 913, 528
New York	78, 431, 317	62, 502, 458	73, 527, 880	89, 975, 134	95, 435, 299
North Carolina	7, 760, 482	5, 456, 479	7, 268, 381	10, 020, 559	9, 261, 467
North Dakota	3, 078, 548	2, 500, 349	3, 693, 095	3, 473, 018	2, 735, 477
Ohio	355, 844, 499	223, 533, 658	236, 808, 638	287, 868, 728	249, 049, 648
Oklahoma	493, 320, 359	269, 882, 786	369, 069, 612	398, 810, 630	393, 030, 665
Oregon	5, 496, 253	5, 199, 803	5, 489, 956	6, 054, 487	7, 364, 232
Pennsylvania	1, 314, 332, 585	944, 688, 650	823, 148, 222	1, 225, 036, 404	1, 011, 630, 879
Rhode Island	1, 175, 653	922, 765	770, 966	1, 022, 528	1, 132, 641
South Carolina	2, 825, 479	1, 754, 491	2, 414, 346	3, 550, 059	3, 444, 366
South Dakota	5, 950, 878	7, 498, 656	7, 278, 934	7, 372, 368	6, 925, 676
Tennessee	55, 023, 232	33, 754, 823	35, 146, 266	41, 553, 789	35, 354, 525
Texas	371, 250, 979	212, 302, 907	249, 604, 173	260, 450, 913	272, 729, 023
Utah	76, 536, 657	40, 595, 872	60, 697, 116	86, 221, 000	84, 356, 626
Vermont	15, 008, 894	10, 650, 213	9, 576, 636	13, 910, 449	14, 549, 429
Virginia	60, 161, 247	32, 810, 842	38, 551, 479	48, 052, 018	37, 962, 143
Washington	26, 677, 191	17, 605, 878	19, 725, 303	22, 169, 191	21, 159, 370
West Virginia	547, 872, 937	316, 180, 647	358, 772, 116	412, 866, 535	307, 314, 205
Wisconsin	19, 630, 114	9, 990, 961	13, 822, 883	19, 089, 600	15, 796, 720
Wyoming	83, 034, 397	51, 365, 150	58, 529, 284	77, 664, 547	75, 494, 166

[a] In this table iron ore, not pig iron, is taken as the basis of valuation of iron, and in the case of other metals mine production (recoverable content of metals) is the basis.

Mineral products of the United States and principal producing States in 1924

Rank in value	Product	Principal producing States [a]	
		In order of quantity	In order of value
20	Aluminum		New York, North Carolina, Tennessee.
33	Antimonial lead	Not separable by States	Not separable by States.
81	Antimony ore	Arkansas, California	Rank same as for quantity.
37	Arsenious oxide	Utah, Montana, Nevada, South Dakota	Do.
76	Asbestos	Arizona, Georgia, California, Maryland	Arizona, Maryland, California, Georgia.
	Asphalt:		
31	Native	Kentucky, Texas, Utah, Oklahoma	Rank same as for quantity.
24	Oil	California, Texas, Illinois, Indiana	Do.
43	Barytes (crude)	Missouri, Georgia, Tennessee, Virginia	Do.
40	Bauxite	Arkansas, Georgia, Tennessee	Do.
(b)	Bismuth	Not separable by States	Not separable by States.
35	Borates	California, Nevada	Rank same as for quantity.
30	Briquets, fuel	Wisconsin, Washington, Pennsylvania, Oregon	Wisconsin, Washington, Oregon, Pennsylvania.
55	Bromine	Michigan, West Virginia, Ohio	Rank same as for quantity.
62	Cadmium (metal and sulphide)	Not separable by States	Not separable by States.
47	Calcium-magnesium chloride (natural)	Michigan, West Virginia, Ohio	Rank same as for quantity.
5	Cement	Pennsylvania, Indiana, California, Michigan	Pennsylvania, California, Indiana, Michigan.
57	Chats	Missouri, Kansas, Oklahoma	Rank same as for quantity.
84	Chromite	California, Oregon	Do.
4	Clay products		Ohio, Pennsylvania, New Jersey, Illinois.
26	Clay, raw	Pennsylvania, Missouri, New Jersey, Georgia	Pennsylvania, New Jersey, Missouri, Georgia.
1	Coal:		
	Bituminous	Pennsylvania, West Virginia, Illinois, Kentucky	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
7	Coke	Pennsylvania, Ohio, Alabama, Indiana	Pennsylvania, Ohio, Indiana, Illinois.
85	Columbite	South Dakota	Rank same as for quantity.
8	Copper	Arizona, Montana, Utah, Michigan	Do.
48	Diatomaceous earth and tripoli	California, Illinois, Oklahoma, Missouri	California, Oklahoma, Illinois, Missouri.
80	Emery	New York, Virginia	Rank same as for quantity.
44	Feldspar (crude)	North Carolina, New Hampshire, Maine, New York	Do.
17	Ferroalloys	Pennsylvania, New York, Ohio, Maryland	Pennsylvania, New York, Maryland, Alabama.
78	Flint lining for tube mills	Minnesota, South Dakota	Rank same as for quantity.
39	Fluorspar	Illinois, Kentucky, Colorado, New Mexico	Do.
38	Fuller's earth	Georgia, Florida, Texas, Illinois	Do.
53	Garnet, abrasive	New York, New Hampshire	Do.
(b)	Gems and precious stones	No canvass for 1924	No canvass for 1924.
15	Gold	California, Colorado, Alaska, South Dakota	Rank same as for quantity.
73	Graphite		Texas, Rhode Island, Alabama, Michigan.
	Amorphous	Rhode Island, Michigan, Nevada	Rank same as for quantity.
	Crystalline	Texas, Alabama	Do.
42	Grindstones and pulpstones	Ohio, West Virginia, Michigan, Washington	Do.
18	Gypsum	New York, Iowa, Michigan, Ohio	New York, Michigan, Iowa, Ohio.

10	Iron ore	Minnesota, Michigan, Alabama, Pennsylvania	Minnesota, Michigan, Alabama, Wisconsin.
3	Iron, pig	Pennsylvania, Ohio, Illinois, Alabama	Rank same as for quantity.
12	Lead	Missouri, Idaho, Utah, Oklahoma	Do.
19	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Ohio, Pennsylvania, Massachusetts, Missouri.
74	Lithium minerals	New Mexico, South Dakota, California	South Dakota, New Mexico, California.
49	Magnesite (crude)	California, Washington	Rank same as for quantity.
70	Magnesium	New York, Michigan	Do.
51	Magnesium chloride (natural)	Michigan, California	Do.
59	Magnesium sulphate (natural)	Michigan, Washington, California	Do.
46	Manganese ore	Montana, Colorado, Washington, Arkansas	Montana, Washington, Arkansas, Virginia.
36	Manganiferous ore	Minnesota, Wisconsin, Michigan, Colorado	Rank same as for quantity.
66	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
64	Calcareous	Virginia, West Virginia, South Carolina, California	Virginia, West Virginia, California, South Carolina.
69	Greensand	New Jersey	Rank same as for quantity.
58	Mica	North Carolina, New Hampshire, South Dakota, Virginia	North Carolina, New Hamsphire, New Mexico, South Dakota.
	Scrap	do	Rank same as for quantity.
	Sheet	New Hampshire, North Carolina, Virginia, Georgia	North Carolina, New Hampshire, New Mexico, Virginia.
79	Millstones		New York, Virginia, North Carolina, New Hamsphire.
22	Mineral paints, zinc and lead pigments	Pennsylvania, Ohio, Colorado, Illinois	Pennsylvania, Ohio, Colorado, Missouri.
(b)	Mineral waters	No canvass for 1924	No canvass for 1924.
65	Molybdenum	Colorado, New Mexico	Rank same as for quantity.
6	Natural gas	Oklahoma, California, West Virginia, Louisiana	West Virginia, Pennsylvania, California, Oklahoma.
13	Natural-gas gasoline	Oklahoma, California, Texas, West Virginia	Rank same as for quantity.
71	Nickel	Not separable by States	Not separable by States.
63	Oilstones, etc	Indiana, New Hampshire, Arkansas, Ohio	Arkansas, Indiana, New Hampshire, Ohio.
56	Peat	New Jersey, Illinois, California, Indiana	Rank same as for quantity.
83	Pebbles for grinding	California, Minnesota, South Dakota	Do.
2	Petroleum	California, Oklahoma, Texas, Arkansas	California, Oklahoma, Texas, Wyoming.
27	Phosphate rock	Florida, Tennessee, Idaho, Kentucky	Rank same as for quantity.
28	Platinum and allied metals	Alaska, California, Oregon, Utah	Do.
50	Potash (K_2O)	California, Maryland, Indiana, Pennsylvania	Do.
68	Pumice	Kansas, Nebraska, California, Utah	Do.
54	Pyrites	California, Virginia, New York, Wisconsin	Do.
52	Quicksilver	California, Texas, Nevada, Oregon	Do.
21	Salt	New York, Michigan, Ohio, Kansas	Michigan, New York, Ohio, Kansas.
11	Sand and gravel	New York, Indiana, Illinois, Michigan	Pennsylvania, New York, Ohio, Illinois.
34	Sand-lime brick	Michigan, Massachusetts, Wisconsin, New Jersey	Michigan, Massachusetts, New Jersey, Wisconsin.
61	Selenium	Not separable by States	Not separable by States.
67	Silica (quartz)	California, Wisconsin, Nevada, Maryland	Wisconsin, Maryland, California, Nevada.
45	Silica sand and sandstone (finely ground)	Illinois, West Virginia, Pennsylvania, New Jersey	Rank same as for quantity.
16	Silver	Utah, Montana, Nevada, Idaho	Do.
25	Slate		Pennsylvania, Vermont, New York, Maine.
41	Sodium salts (other than NaCl) from natural sources.	California, Wyoming, Arizona, Nevada	Rank same as for quantity.
9	Stone	Pennsylvania, Ohio, Michigan, Illinois	Pennsylvania, Indiana, Ohio, New York.
23	Sulphur	Texas, Louisiana, Nevada	Rank same as for quantity.

[a] Rank of States in metal production (except aluminum, ferroalloys, and pig iron) arranged according to mine reports, not smelter output. [b] No canvass for 1924.

Mineral products of the United States and principal producing States in 1924—Continued

Rank in value	Product	Principal producing States	
		In order of quantity	In order of value
29	Sulphuric acid from copper and zinc smelters.	Tennessee, Illinois, Pennsylvania, Ohio	Illinois, Tennessee, Pennsylvania, Ohio.
32	Talc and soapstone	New York, Vermont, Virginia, California	Virginia, New York, Vermont, California.
(b)	Tellurium	Not separable by States	Not separable by States.
82	Tin	Alaska	Rank same as for quantity.
75	Titanium ore (ilmenite)	Florida	Do.
60	Tungsten ore	California, Colorado, Nevada, South Dakota	Do.
72	Uranium and vanadium ores	Utah, Colorado	Colorado, Utah.
14	Zinc	Oklahoma, Kansas, New Jersey, Montana	Oklahoma, New Jersey, Kansas, Montana.
77	Zircon	Florida	Rank same as for quantity.

[b] No canvass for 1924.

States and their principal mineral products in 1924 [a]

State	Rank	Percentage of total value for United States	Principal mineral products in order of value
Alabama	18	1.65	Coal, iron ore, cement, clay products.
Alaska	32	.37	Copper, gold, coal, silver.
Arizona	13	2.15	Copper, gold, silver, lead.
Arkansas	21	1.32	Petroleum, coal, natural gas, bauxite.
California	2	9.16	Petroleum, natural gas, cement, natural-gas gasoline.
Colorado	22	1.31	Coal, gold, clay products, lead.
Connecticut	39	.17	Clay products, stone, sand and gravel, lime.
Delaware	50	.01	Stone, clay products, sand and gravel.
District of Columbia	49	.02	Sand and gravel, clay products, sand-lime brick, stone.
Florida	37	.28	Phosphate rock, stone, fuller's earth, sand and gravel.
Georgia	35	.32	Clay products, stone, cement, fuller's earth.
Idaho	27	.60	Lead, silver, zinc, gold.
Illinois	7	5.04	Coal, clay products, petroleum, cement.
Indiana	10	2.40	Coal, cement, stone, clay products.
Iowa	24	.87	Coal, cement, clay products, gypsum.
Kansas	12	2.25	Petroleum, zinc, coal, natural gas.
Kentucky	8	2.58	Coal, petroleum, clay products, natural gas.
Louisiana	23	1.22	Petroleum, sulphur, natural gas, natural-gas gasoline.
Maine	42	.13	Stone, lime, clay products, slate.
Maryland	31	.40	Cement, coal, clay products, sand and gravel.
Massachusetts	34	.34	Stone, clay products, lime, sand and gravel.
Michigan	9	2.44	Iron ore, copper, cement, clay products.
Minnesota	11	2.31	Iron ore, cement, stone, clay products.
Mississippi	47	.04	Sand and gravel, clay products, stone.
Missouri	16	1.73	Lead, clay products, cement, coal.
Montana	20	1.51	Copper, silver, coal, zinc.
Nebraska	45	.07	Sand and gravel, cement, clay products, stone.
Nevada	28	.56	Copper, silver, gold, gypsum.
New Hampshire	44	.07	Stone, clay products, sand and gravel, feldspar.
New Jersey	19	1.61	Clay products, zinc, cement, sand and gravel.
New Mexico	29	.51	Copper, coal, zinc, silver.
New York	14	2.04	Clay products, gypsum, cement, stone.
North Carolina	38	.20	Clay products, stone, sand and gravel, feldspar.
North Dakota	46	.06	Coal, clay products, sand and gravel, calcareous marl.
Ohio	6	5.33	Clay products, coal, natural gas, petroleum.
Oklahoma	3	8.41	Petroleum, zinc, natural gas, natural-gas gasoline.
Oregon	40	.16	Cement, stone, sand and gravel, clay products.
Pennsylvania	1	21.64	Coal, cement, clay products, natural gas.
Rhode Island	48	.02	Stone, clay products, lime, sand and gravel.
South Carolina	43	.07	Stone, clay products, sand and gravel, calcareous marl.
South Dakota	41	.15	Gold, stone, sand and gravel, silver.
Tennessee	26	.76	Coal, cement, clay products, stone.
Texas	5	5.83	Petroleum, sulphur, natural-gas gasoline, natural gas.
Utah	15	1.80	Copper, lead, coal, silver.
Vermont	36	.31	Stone, slate, lime, talc.
Virginia	25	.81	Coal, clay products, stone, cement.
Washington	30	.45	Coal, cement, clay products, stone.
West Virginia	4	6.57	Coal, natural gas, petroleum, clay products.
Wisconsin	33	.34	Stone, sand and gravel, lime, iron ore.
Wyoming	17	1.61	Petroleum, coal, natural gas, natural-gas gasoline.

[a] In this table iron ore, not pig iron, is taken as the basis of iron valuation and in the case of other metals mine production (recoverable content of metals) is the basis.

Prices of silver, copper, lead, and zinc, 1915–1924

Year	Silver [a]	Copper [b]	Lead [c]	Zinc [d]	Year	Silver [a]	Copper [b]	Lead [c]	Zinc [d]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1915	$0.507	$0.175	$0.047	$0.124	1920	$1.09	$0.184	$0.080	$0.081
1916	.658	.246	.069	.134	1921	1.00	.129	.045	.050
1917	.824	.273	.086	.102	1922	1.00	.135	.055	.057
1918	.98	.247	.071	.091	1923	.82	.147	.070	.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065

[a] Average price furnished by Bureau of the Mint.
[b] For 1915, U. S. Geological Survey computation for electrolytic copper based on quotations by technical journals. For 1916 and later years, average price, all marketable grades.
[c] For 1915, New York price, U. S. Geological Survey computation from daily market spot quotations. For 1916, from outside spot quotations at New York. For 1917 and later years, average price.
[d] Average price, all grades.

DETAILED TABLES

ABRASIVE MATERIALS

PRODUCTION

Natural abrasives sold by producers in the United States, 1922–1924

Abrasive	1922		1923		1924	
	Short tons	Value	Short tons	Value	Short tons	Value
Millstones	(a)	$20,853	(a)	$22,229	(a)	$30,125
Grindstones and pulpstones	26,524	1,020,186	46,570	1,689,315	38,184	1,666,669
Oilstones and scythestones	1,016	197,450	1,223	231,812	1,056	258,943
Emery	1,468	17,511	2,286	29,478	2,195	19,756
Garnet	7,054	566,879	9,006	688,437	8,290	674,176
Abrasive quartz and feldspar	(b)	(b)	(b)	(b)	(b)	(b)
Diatomaceous (infusorial) earth and tripoli (including rottenstone)	74,966	703,397	92,915	1,082,163	91,639	1,083,326
Pumice	45,262	175,600	56,575	214,169	43,651	190,253
Grinding pebbles	3,159	30,798	4,551	51,795	2,532	37,429
Tube-mill lining						
		2,732,674		4,009,398		3,960,677

(a) Figures not available, as product is not reported by weight.
(b) See sections on feldspar and silica.

IMPORTS AND EXPORTS

Value of abrasive materials imported for consumption in the United States, 1920–1924

Material	1920	1921	1922	1923	1924
Millstones and burrstones	$20,954	$13,556	$15,356	$20,102	$6,311
Grindstones and pulpstones	77,046	81,880	81,733	106,028	122,440
Hones, oilstones, and whetstones	56,416	35,761	48,938	53,233	43,579
Emery and corundum	617,187	393,454	389,390	722,688	364,755
Diatomaceous earth, tripoli, and rottenstone	16,323	13,203	16,429	11,779	9,504
Pumice	249,995	173,201	118,458	128,693	111,284
Diamond dust and bort	3,387,488	466,345	1,029,261	228,409	259,482
Flint, flints, and flint stones, unground	338,630	116,157	145,805	130,974	114,958
Garnet	(a)	(a)	a 1,837	93,803	54,402
	4,764,039	1,293,557	1,841,207	1,495,709	1,086,715

a Not separately classified prior to Sept. 22, 1922.

Value of abrasive materials exported from the United States, 1920–1924

Material	1920	1921	192`	1923	1924
Grindstones	$424,322	$281,976	$281,413	$499,123	$481,397
Abrasive wheels, emery, and other	2,791,128	1,318,804	644,151	571,733	521,840
All other natural abrasives, hones, whetstones, etc	3,810,171	1,719,810	292,051	342,737	173,731
	7,025,621	3,320,590	1,217,615	1,413,593	1,176,968

ALUMINUM

[See Bauxite and aluminum]

ANTIMONY AND ANTIMONIAL LEAD

PRODUCTION

Mine production of antimony ores in the United States, 1922–1924, in short tons[a]

Year	Quantity	Antimony content
1922	20	4
1923	40	10
1924	113	33

[a] No production in 1920 and 1921.

Only one smelter reported production (all from foreign ores) in 1920, and the Bureau of Mines is not at liberty to publish the figures. There was no production from 1921 to 1924.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1919–1924

Year	Short tons	Value [a]	Year	Short tons	Value [a]
1919	4,399	$717,900	1922	7,090	$765,700
1920	5,600	938,560	1923	8,021	1,252,800
1921	4,720	464,400	1924	9,404	2,025,600

[a] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1919–1924

Year	Short tons	Value	Antimony content (short tons)	Year	Short tons	Value	Antimony content (short tons)
1919	13,874	$1,513,968	1,943	1922	8,075	$844,993	1,441
1920	12,535	1,963,255	2,033	1923	14,190	1,950,370	2,170
1921	10,064	870,059	1,589	1924	20,787	3,376,713	2,763

IMPORTS AND EXPORTS

Antimony imported for consumption in the United States, 1920–1924

Year	Antimony ore [a]			Liquated antimony sulphide [b]		Metallic antimony [c]		Antimony oxides, and other compounds [d]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1920	1,709	682	$70,285	1,375	$123,902	9,817	$1,216,376	298	$25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558
1922				689	40,108	9,344	659,242	379	65,538
1923	(e)	1,047	44,721	835	64,493	6,763	641,804	2,277	288,206
1924	(e)	899	62,999	558	52,393	6,778	840,434	1,207	190,252

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead"; also as "needle or liquated antimony."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."
[e] Figures not available.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919 [a]	429,059	$33,913	1922 [b]	37,218	$1,548
1920	896,034	51,607	1923	15,958	1,047
1921	299,776	15,741	1924	279,920	14,441

[a] Also 3 short tons of antimony ore, containing 5,380 pounds of antimony, valued at $1,665, was exported in 1919.

[b] During 1922 domestic exports of "matte, regulus, or metal" were 224,610 pounds, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, foreign antimony manufactured in the United States and exported would be classed as domestic exports. Similar exports for 1923 and 1924 are not shown.

ARSENIC

PRODUCTION

White arsenic (refined and crude), produced in the United States, sold in 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	[a] 6,029	$1,181,684	1922	10,027	$1,475,229
1920	11,502	2,021,356	1923	14,271	2,808,801
1921	4,786	717,700	1924	14,453	2,655,015

[a] In addition to the arsenious oxide (or white arsenic) elemental arsenic was produced from ore in 1919. The totals shown include this elemental arsenic.

IMPORTS AND EXPORTS

Arsenic compounds imported for consumption in the United States, 1920–1924

Year	Arsenic or arsenious acid (white arsenic, As_2O_3)		Arsenic and sulphide of, realgar, and orpiment		Sheep dip		Paris green and London purple	
	Short tons	Value	Short tons	Value	Pounds	Value	Pounds	Value
1920	3,740	$532,635	4,080	$684,016	70,168	$5,150	772	$277
1921	1,669	253,250	3,343	531,322	61,377	6,362	325	123
1922 [a]	1,081	162,494	3,815	472,044	70,390	4,877	3,866	741
1923 [b]	10,152	1,985,400	1,097	268,311	87,739	5,237	100,781	20,586
1924 [c]	8,877	1,597,433	234	45,246	114,801	10,764	76,241	15,683

[a] Also 41,296 pounds of "acid," valued at $4,195, and 22,487 pounds of "metallic arsenic," valued at $3,484, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to new tariff.

[b] Also 165,354 pounds of "acid," valued at $15,597; 174,415 pounds of "metallic arsenic," $37,314; and 26 pounds of "lead arsenate," $9.

[c] Also 420 pounds of "acid," valued at $121; 122,467 pounds of "metallic arsenic," $23,684; 3,585 pounds of "lead arsenate," $525; and 3,172 pounds of "calcium arsenate," $278.

Foreign arsenic and sulphide of, or orpiment, exported from the United States, 1919–1924 [a]

Year	Pounds	Value	Year	Pounds	Value
1919			1922	14,290	$1,555
1920	13,799	$1,827	1923	(b)	(b)
1921	23,765	2,835	1924	(b)	(b)

[a] Domestic exports not separately recorded.

[b] Not separately recorded.

ASBESTOS

PRODUCTION

Domestic asbestos sold in the United States, 1920–1924, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	1,245	$661,907	403	$16,324	1,648	$678,231
1921	438	313,268	393	23,700	831	336,968
1922	25	3,320	42	6,800	67	10,120
1923	69	4,433	158	5,193	227	9,626
1924	173	33,941	127	8,585	300	42,526

IMPORTS AND EXPORTS

Asbestos (unmanufactured) imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	167,558	$9,120,253	615	$141,071
1921	72,463	2,948,302	520	101,600
1922	149,427	5,144,700	376	49,939
1923	212,420	7,445,143	680	48,525
1924	183,250	5,602,945	1,270	93,163

ASPHALT AND RELATED BITUMENS

PRODUCTION

Native asphalt and related bitumens sold at mines in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	88,281	$682,989	1922	327,792	$2,253,180
1920	198,497	1,213,908	1923	400,236	2,885,631
1921	296,412	1,985,583	1924	562,367	3,958,339

Asphalt, manufactured in the United States from petroleum, sold at refineries in 1920–1924

Year	From domestic petroleum		From foreign petroleum	
	Short tons	Value	Short tons	Value
1920	700,496	$11,985,457	1,045,779	$14,272,862
1921	624,220	9,048,221	908,093	11,761,358
1922	805,145	10,385,925	1,242,163	13,899,407
1923	995,654	13,060,174	1,378,722	16,840,045
1924	1,158,456	14,305,007	1,920,915	21,710,793

IMPORTS AND EXPORTS

Asphalt and related bitumens imported for consumption in the United States, 1920–1924

Year	Crude asphalt		Ozokerite	
	Short tons	Value	Short tons	Value
1920	127,027	$1,055,951	2,136	$499,758
1921	116,450	972,166	4,274	546,054
1922	120,359	940,873	4,495	371,161
1923	138,430	1,046,603	2,428	213,407
1924	156,662	1,165,253	1,557	207,833

Year	Ichthyol		Bituminous limestone		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1920	98,135	$79,133	1,387	$11,665	130,599	$1,646,507
1921	76,020	107,752	12,085	157,124	132,847	1,783,096
1922	74,330	89,150	4,300	59,590	129,191	1,460,774
1923	[a] 20	15	6,205	33,303	147,063	1,293,328
1924	9,300	17,058	3,354	37,906	161,573	1,428,050

[a] As recorded by Bureau of Foreign and Domestic Commerce. Change in classification under new tariff may account to some extent for great decrease.

Asphalt exported from the United States, 1920–1924

Year	Unmanufactured		Manufactures of (value)	Total value
	Short tons	Value		
1920	51,706	$1,356,116	$842,074	$2,198,190
1921	45,367	1,178,038	621,224	1,799,262
1922	57,362	1,344,440	[a] 1,261,125	2,605,565
1923	72,628	1,500,869	[a] 2,075,628	3,576,497
1924	52,568	1,245,670	[a] 2,212,260	3,457,930

[a] Includes value of squares (10 by 10 feet) of roofing asphalt as follows: 1922, 588,636 squares, $870,200; 1923, 783,028 squares, $1,124,491; 1924, 697,293 squares, $998,469. Corresponding exports not separately shown prior to 1922.

BARYTES AND BARIUM PRODUCTS

BARYTES

PRODUCTION

Crude barytes shipped by producers in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	209,330	$1,727,822	1922	155,040	$1,123,950
1920	228,113	2,142,464	1923	214,183	1,664,156
1921	66,369	531,958	1924	196,332	1,540,744

Crude barytes shipped by producers in the United States, 1923–24, by States

State	1923		1924	
	Short tons	Value	Short tons	Value
Georgia	83,291	$670,343	71,776	$574,208
Missouri	81,701	629,097	77,189	604,390
North Carolina	1,179	7,076	(a)	(a)
Tennessee	34,384	259,005	39,643	302,873
Other States b	13,628	98,635	7,724	59,273
	214,183	1,664,156	196,332	1,540,744

a Included under "Other States."
b 1923: Alabama, California, Kentucky, South Carolina, Virginia, and Wisconsin; 1924: Alabama, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin.

CONSUMPTION

Crude domestic and foreign barytes used in the manufacture of barium products in the United States, 1920–1924, in short tons

Year	In manufacture of—		
	Ground barytes	Lithopone	Barium chemicals
1920	79,052	113,181	37,210
1921	28,296	61,359	10,952
1922	48,280	94,259	25,303
1923	47,713	128,547	34,327
1924	42,855	137,127	33,181

IMPORTS

Crude barytes imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	118	$594	1922	23,239	$104,680
1920	24,874	146,858	1923	15,045	93,721
1921	11,054	59,371	1924	21,502	104,264

Exports of barytes are not separately reported.

BARIUM PRODUCTS

PRODUCTION

Barium products, manufactured in the United States from either domestic or imported crude ore, sold in 1920–1924, in short tons a

Product	1920	1921	1922	1923	1924
Ground barytes	65,748	27,661	46,176	39,605	38,296
Lithopone	89,373	55,016	83,360	98,199	109,469
Barium chemicals:					
Carbonate	7,484	1,956	2,281	6,362	6,058
Chloride	3,084	(b)	2,022	3,301	3,859
Sulphate (blanc fixe)	8,046	2,471	7,349	6,761	7,796
Other c	2,146	1,060	2,249	379	441
	175,881	88,164	143,437	154,607	165,919

a In order to avoid duplication of figures, barium chemicals manufactured from other barium chemicals bought in open market are not included in table.
b Included under "Other."
c 1920: Binoxide, hydroxide, nitrate, and sulphide; 1921: Chloride, hydroxide, and sulphide; 1922: Binoxide, hydroxide, sulphide, and sulphydrate; 1923 and 1924: Hydroxide and sulphide.

IMPORTS AND EXPORTS

Barium products imported for consumption in the United States, 1920–1924

Product	1920	1921	1922	1923	1924	
					Short tons	Value
Manufactured barytes	$3,017	$16,942	$59,453	888,741	2,830	$38,292
Lithopone	263,240	432,019	885,671	776,383	6,830	543,025
Barium carbonate:						
Natural (ground witherite)	61,284	25,188	39,114	41,823	2,500	56,415
Manufactured (chemically precipitated)	37,462	80,603	210,250	79,482	3,752	128,217
Barium binoxide	64,447	127,631	189,334	152,270	860	120,374
Barium chloride	151,778	72,621	112,785	75,014	2,330	100,810
Blanc fixe, or barium sulphate (chemically precipitated)	8,485	22,470	76,445	32,063	1,047	50,465
Barium hydroxide	[a]	[a]	[a] 6,573	16,872	174	8,241
Barium nitrate	[a]	[a]	[a] 16,795	59,766	513	54,638
	589,713	777,474	1,596,420	1,322,414	20,836	1,100,477

[a] Not separately classified prior to Sept. 22, 1922.

Prior to 1922 barium products had not been exported in appreciable quantity, and no separate record of the exports was kept. Exports of lithopone have been as follows: 1922, 1,616 short tons, valued at $169,982; 1923, 1,485 tons, $176,624; 1924, 923 tons, $104,783.

BAUXITE AND ALUMINUM

BAUXITE

PRODUCTION

Bauxite produced in the United States, 1920–1924

Year	Georgia, Alabama, and Tennessee		Arkansas		Total	
	Long tons	Value	Long tons	Value	Long tons	Value
1920	40,029	$349,453	481,279	$2,897,892	521,308	$3,247,345
1921	14,700	134,400	124,850	755,400	139,550	889,800
1922	42,810	329,440	266,790	1,682,890	309,600	2,012,330
1923	28,810	176,030	493,880	2,980,580	522,690	3,156,610
1924	19,940	156,990	327,630	1,981,000	347,570	2,137,990

IMPORTS AND EXPORTS

Bauxite imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1920	42,895	$251,284	22,257	$1,843,596
1921	27,587	164,589	5,942	488,785
1922	23,656	93,805	19,617	961,208
1923	119,020	593,882	78,560	3,380,486
1924	201,974	909,493	77,065	3,979,832

ALUMINUM

PRODUCTION

Value of aluminum produced in the United States, 1919–1924

Year	Primary metal	Secondary metal [a]	Year	Primary metal	Secondary metal [a]
1919	$38,558,000	$12,014,600	1922	$13,622,000	$6,085,900
1920	41,375,000	9,489,100	1923	28,305,000	10,824,600
1921	10,906,000	3,775,400	1924	37,607,000	14,596,200

[a] Value of secondary aluminum based on average price at New York, as given by American Metal Market.

IMPORTS AND EXPORTS

Aluminum imported for consumption in the United States, 1920–1924

Year	Crude and semicrude [a]		Manufactures of [b]	Total value
	Pounds	Value		
1920	39,298,649	$12,183,891	$893,131	$13,077,022
1921	32,559,017	7,627,508	1,262,283	8,889,791
1922	43,891,933	8,286,819	1,408,193	9,695,012
1923	42,476,789	8,316,816	425,747	8,742,563
1924	31,809,941	6,859,785	285,251	7,145,036

[a] Includes crude aluminum, plates, sheets, wire, etc.
[b] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

Aluminum and manufactures of aluminum exported from the United States, 1920–1924

Year	Crude and semicrude [a]		Manufactures of	Total value
	Pounds	Value		
1920	9,407,631	$3,067,617	$2,563,164	$5,630,781
1921	2,196,378	801,075	2,307,782	3,108,857
1922	4,347,020	1,127,460	[b] 1,708,656	2,836,116
1923	5,539,671	1,517,562	[b] 2,053,977	3,571,539
1924	6,343,512	1,632,315	[b] 2,540,075	4,172,390

[a] Includes ingots, metal and alloys, plates and sheets, etc.
[b] Represents value of 4,544,949 pounds in 1922, 5,402,034 pounds in 1923, and 6,783,240 pounds in 1924 of tubes, moldings, castings, and other shapes, table, kitchen, or hospital utensils, and other manufactures. Figures of quantity not available prior to 1922.

BISMUTH

PRODUCTION

The bismuth produced in the United States is a by-product obtained in the refining of lead and tin bullion, part of which is from ores of foreign origin. Figures of production are not available for publication.

IMPORTS

Bismuth imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	57,607	$55,179	1922[a]	121,505	$239,777
1920	72,771	161,877	1923[a]	62,640	146,178
1921	94,085	114,891	1924[a]	18,494	39,653

[a] Also 9,392 pounds of "compounds, mixtures, and salts of bismuth," valued at $8,681, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to new tariff. Similar additional imports in 1923 were 11,731 pounds, valued at $13,717, and in 1924, 10,066 pounds, valued at $12,533.

Exports of bismuth are not separately recorded.

BORAX

[See Sodium salts (natural)]

BRIQUETS (FUEL)

Fuel briquets produced in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	295,734	$2,301,054	1922	619,425	$5,444,926
1920	567,192	4,623,831	1923	696,810	5,898,698
1921	398,949	3,632,301	1924	580,470	4,986,622

BROMINE

PRODUCTION

Bromine sold by producers in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	1,854,971	$1,234,969	1922	1,005,174	$150,668
1920	1,160,584	745,381	1923	842,352	146,176
1921	711,953	172,759	1924	2,033,804	594,685

IMPORTS

Imports of bromine have been as follows: 1924, 37,318 pounds, valued at $8,958; 1923, 782 pounds, $1,171; 1922, 1,094 pounds, $339; 1921, 300 pounds, $84. No imports were recorded for 1920. Exports are not specifically shown.

CADMIUM

PRODUCTION

Metallic cadmium and cadmium sulphide produced in the United States, 1920–1924

Year	Metallic cadmium		Cadmium sulphide	
	Pounds	Value	Pounds	Value
1920	129,283	$151,261	32,133	$37,274
1921	68,501	67,131	65,446	71,336
1922	131,590	143,433	134,774	152,295
1923	183,816	161,758	(a)	(a)
1924	129,328	77,597	(a)	(a)

[a] Bureau of Mines not at liberty to publish figures.

IMPORTS

Imports of cadmium for consumption have been as follows: 1924, 1,102 pounds, valued at $743; 1923, 16 pounds, $119; 1922, 2,240 pounds, $2,434; 1921, 101 pounds, $216; 1920, none.

Exports of cadmium are not separately recorded.

CALCIUM CHLORIDE

PRODUCTION

Calcium-magnesium chloride, from natural brines, sold by producers in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	26,123	$321,596	1922	33,067	$571,326
1920	27,849	539,471	1923	44,961	663,384
1921	23,672	510,723	1924	58,791	1,164,848

IMPORTS

Imports of calcium chloride have been as follows: 1924, 3,996 short tons, valued at $54,542; 1923, 3,232 tons, $48,527. From September 22 to December 31, 1922, 740 tons, valued at $8,563, was imported. Similar imports were not separately recorded prior to new tariff.

Exports of calcium chloride are not separately shown.

CARBON BLACK

Carbon black produced from natural gas in the United States, 1920–1924

Year	Number of producers reporting	Carbon black produced		Natural gas used (estimate)
		Pounds	Value	M cubic feet
1920	19	51,321,892	$4,032,286	40,599,000
1921	23	59,766,315	5,445,878	50,565,000
1922	26	67,795,129	5,819,618	53,629,000
1923	47	138,262,648	11,692,066	109,096,000
1924	46	186,872,034	11,564,936	156,514,000

CEMENT

PRODUCTION

Hydraulic cements shipped from mills in the United States, 1920–1924

Year	Masonry, natural, and puzzolan cements		Portland cement		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1920	767,481	$1,150,890	96,311,719	$194,439,025	97,079,200	$195,589,915
1921	539,402	897,025	95,507,147	180,778,415	96,046,549	181,675,440
1922	889,428	1,293,598	117,701,216	207,170,430	118,590,644	208,464,028
1923	1,271,674	1,947,352	135,912,118	257,684,424	137,183,792	259,631,776
1924	1,418,461	2,006,559	146,047,549	264,046,708	147,466,010	266,053,267

Portland cement produced in the United States, 1919–1924, in barrels

1919	80,777,935	1922	114,789,984
1920	100,023,245	1923	137,460,238
1921	98,842,049	1924	149,358,109

Portland cement produced, shipped, and in stock in the United States, 1923–24, by States and districts

	Production				Shipments				Stock, Dec. 31 (barrels)	
	Active plants		Barrels		1923		1924			
	1923	1924	1923	1924	Barrels	Value	Barrels	Value	1923	1924
STATE										
Alabama	5	5	3,497,256	5,552,550	3,395,392	$6,257,673	5,542,687	$9,147,367	136,765	146,628
California	9	10	11,001,910	11,615,379	10,882,802	26,022,156	11,481,730	25,532,707	369,035	502,684
Illinois	4	4	7,147,906	6,994,323	7,129,208	12,550,100	6,955,455	12,026,310	661,942	700,810
Iowa	5	5	5,732,470	5,624,466	5,570,675	10,351,971	4,881,613	8,811,587	952,240	1,695,093
Kansas	7	7	6,025,657	5,894,236	5,878,839	10,868,590	5,809,646	9,960,547	768,860	853,450
Michigan	14	15	7,619,792	9,259,781	7,466,283	14,038,322	8,991,270	16,405,761	782,377	1,050,888
Missouri	5	5	7,305,997	7,871,621	7,143,883	13,237,141	7,711,206	13,515,267	774,922	935,337
New York	9	9	6,990,174	7,571,856	6,853,062	12,834,471	7,435,875	13,460,594	653,263	789,244
Ohio	6	7	4,188,755	4,600,835	4,083,321	7,615,741	4,295,027	7,836,325	353,782	656,590
Pennsylvania	22	22	38,157,482	40,849,602	38,610,852	69,792,343	40,208,860	69,693,517	2,121,365	2,762,107
Texas	5	5	4,178,895	4,565,983	4,091,284	8,011,226	4,488,143	8,322,658	278,372	356,212
Washington	4	4	2,105,711	1,842,113	2,111,479	4,988,022	1,793,403	4,236,554	240,892	289,602
Other States [a]	31	34	33,508,233	37,115,364	32,775,038	61,116,668	36,449,634	65,157,514	2,718,824	3,384,554
	126	132	137,460,238	149,358,109	135,912,118	257,684,424	146,047,549	264,046,708	10,812,639	14,123,199
COMMERCIAL DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	22	22	35,721,751	38,656,739	36,133,963	65,536,543	37,989,250	65,500,657	1,877,051	2,544,540
New York	9	9	6,990,174	7,571,856	6,853,062	12,834,471	7,435,875	13,460,594	653,263	789,244
Ohio, western Pennsylvania, and West Virginia	11	12	13,495,799	14,331,451	13,211,380	24,183,471	14,028,762	25,104,849	1,067,227	1,369,916
Michigan	14	15	7,619,792	9,259,781	7,466,283	14,038,322	8,991,270	16,405,761	782,377	1,050,888
Wisconsin, [b] Illinois, Indiana, and Kentucky	10	11	21,193,666	21,823,469	21,056,914	37,010,579	21,343,396	37,189,604	1,571,161	2,051,234
Virginia, Tennessee, Alabama, and Georgia	11	12	7,908,846	11,411,054	7,620,850	14,210,617	11,374,280	19,201,389	457,593	494,367
Eastern Missouri, Iowa, Minnesota, and South Dakota [c]	10	11	14,037,099	14,822,738	13,624,173	25,022,674	13,984,167	24,757,538	1,905,675	2,744,246
Western Missouri, Nebraska, Kansas, and Oklahoma	11	11	9,779,034	9,892,813	9,573,003	18,185,384	9,586,984	16,262,422	1,163,033	1,468,862
Texas	5	5	4,178,895	4,565,983	4,091,284	8,011,226	4,488,143	8,322,658	278,372	356,212
Colorado and Utah	5	5	2,427,971	2,423,830	2,340,386	5,163,340	2,377,774	5,081,599	269,934	315,990
California	9	10	11,001,910	11,615,379	10,882,802	26,022,156	11,481,730	25,532,707	369,035	502,684
Oregon, Washington, and Montana	9	9	3,105,301	2,983,016	3,058,018	7,465,641	2,965,918	7,226,930	417,918	435,016
	126	132	137,460,238	149,358,109	135,912,118	257,684,424	146,047,549	264,046,708	10,812,639	14,123,199

[a] Colorado, Georgia, Indiana, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, Tennessee, Utah, Virginia, and West Virginia; also South Dakota and Wisconsin in 1924.

[b] Began producing and shipping in June, 1924.

[c] South Dakota began producing in December, 1924.

IMPORTS AND EXPORTS

Cement imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Barrels	Value	Barrels	Value
1920	524,604	$1,254,729	2,985,807	$10,015,369
1921	122,317	388,842	1,181,014	4,276,986
1922	355,931	692,429	1,127,845	3,206,201
1923	1,767,264	3,145,977	1,001,688	2,944,174
1924	2,023,663	3,139,788	878,543	2,615,154

CHROMITE

PRODUCTION

Chromite shipped from mines in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	5,079	$129,302	1922	355	$7,288
1920	2,502	44,857	1923	227	3,819
1921	282	2,900	1924	288	1,140

IMPORTS

Crude chromite imported for consumption in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	61,404	$1,381,497	1922	90,081	$741,186
1920	150,275	1,921,824	1923	129,693	1,123,120
1921	81,836	654,602	1924	118,343	1,095,603

There are no exports of chromite.

CLAY

PRODUCTION

Clay sold by producers in the United States, 1920–1924

Year	Kaolin, china clay, and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	268,203	$2,865,407	69,477	$584,611	9,006	$41,519	2,261,915	$7,088,049
1921	162,726	1,579,163	54,014	354,565	4,608	14,841	1,195,861	3,560,373
1922	275,675	2,346,095	76,792	440,877	4,050	19,405	1,679,220	4,633,486
1923	336,803	2,926,255	97,068	620,978	8,520	43,609	2,298,163	6,565,899
1924	326,611	2,923,965	83,034	581,966	5,910	31,023	2,443,710	6,737,063

Year	Stoneware clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	106,350	$229,221	322,100	$467,856	3,037,051	$11,276,663
1921	86,574	184,540	242,963	361,818	1,746,746	6,055,300
1922	86,866	164,870	525,097	725,781	2,647,700	8,330,514
1923	81,389	194,358	612,717	837,814	3,434,660	11,188,913
1924	59,194	117,142	772,660	1,116,377	3,691,119	11,507,536

IMPORTS AND EXPORTS

Clay imported for consumption in the United States, 1920–1924

Year	Kaolin or china clay		Common blue and Gross Almerode glass-pot clay		All other clays				Total	
					Unwrought		Wrought			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	361,800	$3,568,677	6,837	$157,201	34,252	$272,524	691	$10,267	403,580	$4,008,669
1921	162,906	1,546,285	4,468	77,217	41,421	348,870	120	2,313	208,915	1,974,685
1922	310,136	2,963,420	7,323	84,415	40,624	327,388	2,566	29,398	360,649	3,404,621
1923	311,298	3,046,191	12,999	121,272	65,379	481,614	1,676	21,892	391,352	3,670,969
1924	353,124	3,188,454	7,059	62,883	82,562	706,018	1,322	18,685	444,067	3,976,040

Domestic clay exported from the United States, 1920–1924

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	54,125	$393,177	66,035	$775,222	120,160	$1,168,399
1921	23,666	177,979	23,779	183,449	47,445	361,428
1922	24,391	169,664	[a] 23,285	[a] 267,908	47,676	437,572
1923	50,055	303,675	34,840	329,192	84,895	632,867
1924	41,704	312,676	31,051	420,040	72,755	732,716

[a] Includes 2,091 short tons of "kaolin, china clay, and paper clay," valued at $27,840. Similar exports not shown separately for other years.

CLAY PRODUCTS

PRODUCTION

Clay products of the United States, 1923–24, by products [•]

Product	1923		1924	
	Quantity	Value	Quantity	Value
Common brick ..... thousands	7,282,181	$94,472,666	7,158,714	$86,691,550
Vitrified brick or block ..... do	699,269	15,569,670	554,440	12,973,904
Face brick ..... do	1,931,175	38,891,834	2,030,403	39,931,055
Fancy or ornamental brick ..... do	12,879	252,323	538	33,419
Enameled brick ..... do	19,502	1,670,852	21,074	1,789,012
Architectural terra cotta ..... short tons	138,462	16,486,039	140,624	16,445,630
Fireproofing and hollow building tile ..... do	3,764,744	28,274,801	3,534,784	24,998,068
Tile (not drain)	.....	23,804,157	.....	24,841,813
Draintile ..... short tons	615,640	5,099,955	592,641	4,817,390
Sewer pipe ..... do	1,777,584	29,102,511	1,951,612	32,399,971
Stove lining ..... do	54,684	1,218,970	41,986	1,036,767
Fire brick ..... thousands	1,134,223	46,676,637	955,399	40,620,941
Miscellaneous	.....	8,111,146	.....	11,184,873
Total brick and tile	.....	309,631,561	.....	297,764,393
Total pottery	.....	114,951,067	.....	118,014,985
Grand total	.....	424,582,628	.....	415,779,378

• Figures obtained through cooperation with Bureau of the Census.

Value of clay products of the United States, 1923–24, by States [a]

State	1923				1924			
	Number of firms reporting	Brick and tile	Pottery	Total	Number of firms reporting	Brick and tile	Pottery	Total
Alabama	45	$3,914,677	$6,890	$3,921,567	46	$4,221,024	$13,712	$4,234,736
Arizona	7	102,337		102,337	5	98,564		98,564
Arkansas	17	1,202,857	(b)	[c] 1,202,857	17	1,356,425	(b)	[c] 1,356,425
California	86	17,016,093	3,816,960	20,833,053	86	17,506,122	3,488,610	20,994,732
Colorado	43	4,036,594	377,008	4,413,602	37	3,672,879	281,760	3,954,639
Connecticut and Rhode Island	31	3,892,992	(b)	[c] 3,892,992	29	3,710,624	(b)	[c] 3,710,624
Delaware	11	249,804		249,804	11	235,555		235,555
District of Columbia	4	242,980	(b)	[c] 242,980	3	(b)	(b)	175,252
Florida	11	214,157	(b)	[c] 214,157	10	239,073	(b)	[c] 239,073
Georgia	40	5,731,268	7,860	5,739,128	41	6,008,618	24,332	6,032,950
Idaho	5	135,920		135,920	6	205,172		205,172
Illinois	147	29,527,311	4,691,676	34,218,987	140	28,298,188	5,293,180	33,591,368
Indiana	110	12,747,678	2,895,450	15,643,128	103	12,493,776	3,874,363	16,368,139
Iowa	77	6,920,336	(b)	[c] 6,920,336	69	5,669,810	(b)	[c] 5,669,810
Kansas	29	4,425,067		4,425,067	29	4,024,535		4,024,535
Kentucky	44	7,409,056	201,123	7,610,179	44	7,316,651	202,588	7,519,239
Louisiana	20	731,252	(b)	[c] 731,252	18	324,064	(b)	[c] 324,064
Maine	17	877,555		877,555	17	707,044		707,044
Maryland	33	3,016,790	1,892,708	4,909,498	33	2,705,975	1,267,099	3,973,074
Massachusetts	45	3,002,341	1,192,514	4,194,855	42	2,546,926	1,312,327	3,859,253
Michigan	44	4,224,634	2,734,644	6,959,278	37	6,912,135	3,334,818	10,246,953
Minnesota	27	2,031,408	(b)	[c] 2,031,408	24	1,675,204	(b)	[c] 1,675,204
Mississippi	23	878,684	(b)	[c] 878,684	26	930,649	24,679	955,328
Missouri	66	17,802,813	100,961	17,903,774	64	16,242,225	95,936	16,338,161
Montana	12	312,219		312,219	9	181,057		181,057
Nebraska	23	939,138	(b)	[c] 939,138	21	796,725	(b)	[c] 796,725
Nevada	1	(b)		(b)	1	(b)		(b)
New Hampshire	12	913,389	(b)	[c] 913,389	14	868,444		868,444
New Jersey	134	21,182,130	23,739,584	44,921,714	129	20,445,851	25,968,316	46,414,167
New Mexico	3	133,118		133,118	3	18,611		18,611
New York	124	18,872,794	6,353,393	25,226,187	117	17,719,165	8,421,523	26,140,688
North Carolina	73	3,656,452	(b)	[c] 3,656,452	78	3,989,381	11,050	4,000,431
North Dakota	3	181,933		181,933	4	168,855		168,855
Ohio	397	56,070,190	43,008,797	99,078,987	384	56,216,577	41,615,064	97,831,641
Oklahoma	20	1,870,436		1,870,436	21	1,963,484		1,963,484
Oregon	14	612,785	(b)	[c] 612,785	13	701,577	(b)	[c] 701,577
Pennsylvania	326	50,667,046	7,862,435	58,529,481	308	43,935,463	8,231,903	52,167,366
South Carolina	25	1,448,790	(b)	[c] 1,448,790	26	1,477,784	33,370	1,511,154
South Dakota	2	(b)		(b)	2	(b)		(b)
Tennessee	45	4,244,092	635,756	4,879,848	42	4,245,390	687,762	4,933,152
Texas	58	5,429,127	143,538	5,572,665	57	5,364,911	104,997	5,469,908
Utah	13	930,831	5,870	936,701	14	1,047,199	(b)	[c] 1,047,199
Vermont	1	(b)		(b)	2	(b)		(b)
Virginia	47	3,879,102	439,650	4,318,752	52	3,866,761	421,879	4,288,640
Washington	32	2,265,706	30,536	2,296,242	29	2,583,707	23,690	2,607,397
West Virginia	53	4,336,501	13,237,595	17,574,096	44	3,571,288	12,053,734	15,625,022
Wisconsin	36	1,058,138	(b)	[c] 1,058,138	40	1,063,164	(b)	[c] 1,063,164
Wyoming	5	136,493		136,493	6	126,606		126,606
Undistributed		156,547	1,576,119	1,732,666		311,155	1,228,293	1,364,196
	2,441	309,631,561	114,951,067	424,582,628	2,353	297,764,393	118,014,985	415,779,378

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Included under "Undistributed."
[c] Exclusive of pottery, value for which is included under "Undistributed."

IMPORTS AND EXPORTS

Value of clay products imported for consumption in the United States, 1920–1924

Year	Pottery								Brick, fire brick, tile, and miscellaneous clay products	Grand total
	Brown earthen and common stone ware [a]	Tobacco pipes and pipe bowls of clay	Earthenware and crockery composed of a non-vitrified absorbent body		China and porcelain		Sanitary earthenware decorated and not decorated	Total		
			Not decorated	Decorated	Not decorated	Decorated				
1920	$390,962	$12,091	$340,676	$3,805,955	$431,636	$5,856,384	$13,068	$10,850,772	$252,656	$11,103,428
1921	288,893	11,535	405,370	3,871,554	646,427	6,918,179	12,067	12,154,025	228,804	12,382,829
1922	341,997	15,638	339,066	4,427,001	641,261	6,298,440	17,295	12,080,698	375,764	12,456,462
1923	263,388	26,606	881,480	4,916,906	864,239	8,830,266	346,589	16,129,474	864,124	16,993,598
1924	314,721	14,517	765,070	5,041,570	799,472	9,504,905	125,100	16,565,655	690,639	17,256,294

[a] Including Rockingham ware and miscellaneous pottery products.

Value of clay products of domestic manufacture exported from the United States, 1920–1924

Year	Building brick	Fire brick	Tile (except drain)	Earthen and stone ware	China	Sanitary earthenware	All other	Total
1920	$382,814	$4,200,266	$1,025,083	$1,241,938	$816,817	$778,714	$951,991	$9,397,623
1921	415,402	2,314,911	814,456	1,014,329	312,161	535,506	873,182	6,279,947
1922	210,215	1,581,679	390,408	981,082	316,973	561,536	[a] 1,599,949	5,641,842
1923	282,454	2,332,536	373,866	932,779	334,146	657,859	[a] 1,915,842	6,829,482
1924	222,033	1,463,412	400,452	753,652	259,098	745,746	[a] 1,863,324	5,707,717

[a] Includes electric porcelain valued at $1,379,750 in 1922, $1,783,614 in 1923, and $1,767,323 in 1924; not separately classified prior to 1922.

COAL

PRODUCTION

Coal produced in the United States, 1920–1924

Year	Pennsylvania anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	89,598,249	$434,252,198	568,666,683	$2,129,933,000	658,264,932	$2,564,185,000
1921	90,473,451	452,304,903	415,921,950	1,199,983,600	506,395,401	1,652,288,600
1922	54,683,022	273,700,125	422,268,099	1,274,820,000	476,951,121	1,548,520,000
1923	93,339,009	506,786,768	564,564,662	1,514,621,000	657,903,671	2,021,408,000
1924	87,926,862	477,230,852	483,686,538	1,062,626,000	571,613,400	1,539,857,000

Coal produced in the United States, 1923–24, by States

State	1923 (including wagon mines)		1924 (excluding wagon mines)	
	Short tons	Value	Short tons	Value
Alabama	20,457,649	$51,624,000	19,130,184	$44,756,000
Alaska	119,826	755,000	99,663	560,000
Arkansas	1,296,892	5,192,000	1,451,503	5,898,000
California, Idaho, Nebraska,[a] and Oregon	20,066	79,000	16,953	71,000
Colorado	10,346,218	33,299,000	10,444,098	31,863,000
Georgia	75,620	327,000	74,947	271,000
Illinois	79,310,075	198,388,000	68,323,281	155,260,000
Indiana	26,229,099	65,046,000	21,480,213	46,153,000
Iowa	5,710,735	20,517,000	5,468,450	18,097,000
Kansas	4,443,149	14,275,000	4,247,733	12,854,000
Kentucky	44,777,317	113,542,000	45,147,204	84,733,000
Maryland	2,285,926	6,911,000	2,133,703	4,629,000
Michigan	1,172,075	5,545,000	831,020	3,602,000
Missouri	3,403,151	11,575,000	2,480,880	8,154,000
Montana	3,147,678	9,652,000	2,905,365	8,596,000
New Mexico	2,915,173	10,668,000	2,786,063	9,774,000
North Carolina	36,019	132,000	57,094	224,000
North Dakota	1,385,400	3,275,000	1,200,527	2,473,000
Ohio	40,546,443	98,610,000	30,473,007	62,011,000
Oklahoma	2,885,038	10,874,000	2,329,615	8,590,000
Pennsylvania (bituminous)	171,879,913	472,217,000	130,633,773	295,164,000
South Dakota	10,379	25,060	12,043	36,000
Tennessee	6,040,268	16,515,000	4,556,555	9,711,000
Texas	1,187,329	2,162,000	1,147,011	1,721,000
Utah	4,720,217	13,657,000	4,488,157	12,057,000
Virginia	11,761,643	32,468,000	10,693,464	21,823,000
Washington	2,926,392	10,894,000	2,653,667	9,689,000
West Virginia	107,899,941	285,481,000	101,662,897	185,229,000
Wyoming	7,575,031	20,916,000	6,757,468	18,327,000
Total bituminous	564,564,662	1,514,621,000	483,686,538	1,062,626,000
Pennsylvania anthracite	93,339,009	506,786,768	87,926,862	477,230,852
Grand total	657,903,671	2,021,408,000	571,613,400	1,539,857,000

[a] No production reported from Nebraska for 1923.

Coal produced in the United States, 1923–24, by months, in short tons

Month	Pennsylvania anthracite		Bituminous	
	1923	1924	1923	1924
January	8,521,000	7,724,000	51,944,000	52,507,000
February	7,602,000	7,428,000	43,645,000	47,302,000
March	9,175,000	7,908,000	48,446,000	41,288,000
April	7,885,000	6,839,000	44,057,000	30,429,000
May	8,384,000	7,549,000	47,690,000	32,276,000
June	8,474,000	7,509,000	47,083,000	31,458,000
July	8,136,000	7,584,000	46,707,000	33,346,000
August	8,672,000	6,906,000	50,578,000	35,923,000
September	2,853,000	7,408,000	47,841,000	42,376,000
October	8,532,000	7,479,000	50,907,000	48,414,000
November	7,575,000	6,604,000	44,425,000	42,102,000
December	7,530,000	7,189,000	41,242,000	46,266,000
	93,339,000	87,927,000	564,565,000	483,687,000

IMPORTS AND EXPORTS

Coal imported for consumption in the United States, 1920–1924

Year	Anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	31,748	$257,835	1,244,990	$6,733,676	1,276,738	$6,991,511
1921	8,894	93,103	1,257,589	7,363,945	1,266,483	7,457,048
1922	233,528	1,502,192	5,059,999	26,747,374	5,293,527	28,249,566
1923	300,360	2,114,080	1,881,465	10,128,516	2,181,825	12,242,596
1924	117,914	880,364	416,736	2,135,402	534,650	3,015,766

Coal exported from the United States, 1920–1924

Year	Anthracite		Bituminous [a]		Total [a]	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	5,403,749	$45,538,100	38,517,084	$304,273,241	43,920,833	$349,811,341
1921	4,677,368	45,624,555	23,131,166	122,597,038	27,808,534	168,221,593
1922	2,649,457	25,350,677	12,413,085	65,891,740	15,062,542	91,242,417
1923	5,090,138	49,577,339	21,453,579	104,546,585	26,543,717	154,123,924
1924	4,017,785	40,067,804	17,100,347	70,971,302	21,118,132	111,039,106

[a] Exclusive of bunker coal, which has been as follows: 1920, 10,485,639 short tons, valued at $82,461,518; 1921, 8,453,220 tons, $52,277,668; 1922, 4,614,632 tons, $27,912,957; 1923, 5,093,024 tons, $31,469,788; 1924, 4,460,412 tons, $22,883,293.

COBALT

PRODUCTION

No cobalt ore is known to have been produced in the United States during 1924 or 1923. In 1922, one carload of heterogenite (cobalt oxide), weighing 42,086 pounds and containing 4,018 pounds of cobalt, was shipped and was sold for $1,419. No production was reported for 1921, but 102,410 pounds of cobalt oxide and cobalt hydrate, valued at $262,801, was recovered from ore in 1920.

IMPORTS

Cobalt ore, cobalt, and oxide imported for consumption in the United States, 1920–1924

Year	Ore		Cobalt		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	13,039	$4,794	143,603	$326,864	202,724	$399,605	[a] 359,586	[a] $731,277
1921	7,657	3,235	38,442	105,539	164,003	342,426	210,102	451,200
1922	5,195	7,075	126,364	321,396	217,530	435,895	[b] 349,089	[b] 764,366
1923	58,719	56,326	225,639	552,434	258,574	511,903	[b] 542,932	[b] 1,120,663
1924	28,786	37,276	118,952	264,935	226,703	440,898	[b] 374,441	[b] 743,109

[a] Includes 220 pounds of zaffer, valued at $14. No zaffer imported 1921–1924.
[b] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to new tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356, and in 1924, 797 pounds, $866.

COKE

PRODUCTION

Coke produced in the United States, 1920–1924

Year	Beehive		By-product		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	20,511,092	$162,952,483	30,833,951	$313,028,732	51,345,043	$475,981,215
1921	5,538,042	30,166,449	19,749,580	117,506,646	25,287,622	147,673,095
1922	8,573,467	50,036,556	28,550,545	188,276,767	37,124,012	238,313,323
1923	19,379,870	115,905,580	37,597,664	257,591,318	56,977,534	373,496,898
1924	10,286,037	48,351,552	33,983,568	195,690,009	44,269,605	244,041,561

Coke produced in the United States, 1923–24, by States

State	1923		1924	
	Short tons	Value [a]	Short tons	Value [a]
Alabama	4,654,075	$19,817,394	4,541,058	$17,404,066
Colorado	647,823	[b]	735,520	[b]
Georgia	12,556	126,690	8,081	71,355
Illinois	3,187,168	30,373,638	2,355,474	20,187,519
Indiana	5,042,614	46,765,264	4,272,435	30,394,497
Kentucky	559,711	[b]	[c]	[c]
Maryland	861,668	[b]	810,118	[b]
Massachusetts	554,125	[b]	397,640	[b]
Michigan	1,648,773	14,389,742	1,770,547	11,914,028
Minnesota	695,824	5,104,330	514,764	4,903,891
Missouri	[c]	[c]	[c]	[c]
New Jersey	897,569	[b]	869,120	[b]
New Mexico	[c]	[c]	83,070	[b]
New York	1,783,948	12,808,335	1,600,669	11,108,944
Ohio	6,473,606	[b]	5,832,699	[b]
Oklahoma	[c]	[c]		
Pennsylvania	25,624,286	138,444,191	16,927,437	72,568,096
Rhode Island	[c]	[c]	[c]	[c]
Tennessee	304,511	2,069,553	207,475	1,012,064
Utah	232,941	1,977,669	257,094	[b]
Virginia	774,887	5,086,612	485,064	2,343,081
Washington	69,068	584,512	71,615	573,644
West Virginia	1,762,775	11,103,716	1,328,569	6,048,638
Wisconsin	[c]	[c]	[c]	[c]
Combined States	1,189,606	13,083,700	1,201,156	9,843,475
Undistributed		71,761,552		55,668,263
	56,977,534	373,496,898	44,269,605	244,041,561

[a] Includes operators' statements of value for that portion of product not sold (such as coke consumed by producer in associated iron furnaces).
[b] Included under "Undistributed."
[c] Included under "Combined States."

Coke produced in the United States, 1923–24, by States and kinds

State	Beehive				By-product			
	1923		1924		1923		1924	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	268,709	$1,660,903	154,686	$840,843	4,385,366	$18,156,491	4,386,372	$16,563,223
Colorado	199,580	(a)	212,115	(a)	448,243	(a)	523,405	(a)
Georgia	12,556	126,690	8,081	71,355				
Illinois					3,187,168	30,373,638	2,355,474	20,187,519
Indiana					5,042,614	46,765,264	4,272,435	30,394,497
Kentucky	125,595	874,752	79,248	(a)	434,116	(a)	(b)	(b)
Maryland					861,668	(a)	810,118	(a)
Massachusetts					554,125	(a)	397,640	(a)
Michigan					1,648,773	14,389,742	1,770,547	11,914,028
Minnesota					695,824	5,104,330	514,764	4,903,891
Missouri					(b)	(b)	(b)	(b)
New Jersey					897,569	(a)	869,120	(a)
New Mexico	(b)	(b)	83,070	(a)				
New York					1,783,948	12,808,335	1,600,669	11,108,944
Ohio	149,796	(a)	109,625	(a)	6,323,810	40,712,282	5,723,074	31,008,209
Oklahoma	(b)	(b)						
Pennsylvania	16,438,539	94,923,942	8,501,282	37,893,584	9,185,747	43,520,249	8,426,155	34,674,512
Rhode Island					(b)	(b)	(b)	(b)
Tennessee	180,351	1,244,011	131,755	635,736	124,160	825,542	75,720	376,328
Utah	232,941	1,977,669	159,744	1,310,929			97,350	(a)
Virginia	774,887	5,086,612	485,064	2,343,081				
Washington	37,987	347,364	31,712	289,934	31,081	237,148	39,903	283,710
West Virginia	821,909	5,758,284	329,655	1,646,452	940,866	5,345,432	998,914	4,402,186
Wisconsin					(b)	(b)	(b)	(b)
Combined States	137,020	1,157,400			1,052,586	11,926,300	1,121,908	9,387,943
Undistributed		2,747,953		3,319,638		27,426,565		20,485,019
	19,379,870	115,905,580	10,286,037	48,351,552	37,597,664	257,591,318	33,983,568	195,690,009

(a) Included under "Undistributed." (b) Included under "Combined States."

Coke produced in the United States in 1924, by months, in short tons

Month	Beehive	By-product	Total
January	1,228,000	3,093,000	4,321,000
February	1,288,000	2,980,000	4,268,000
March	1,429,000	3,220,000	4,649,000
April	1,148,000	3,009,000	4,157,000
May	810,000	2,807,000	3,617,000
June	590,000	2,425,000	3,015,000
July	476,000	2,369,000	2,845,000
August	462,000	2,445,000	2,907,000
September	556,000	2,545,000	3,101,000
October	671,000	2,899,000	3,570,000
November	670,000	2,926,000	3,596,000
December	958,000	3,266,000	4,224,000
Total, 1924	10,286,000	33,984,000	44,270,000
Monthly average: 1924	857,000	2,832,000	3,689,000
1923	1,615,000	3,133,000	4,748,000
1922	714,000	2,379,000	3,093,000
1921	462,000	1,646,000	2,108,000
1920	1,709,000	2,569,000	4,278,000

IMPORTS AND EXPORTS

Coke imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	41,143	$403,175	919,802	$9,993,665
1921	30,990	336,394	306,755	2,760,939
1922	94,228	802,987	511,541	4,319,538
1923	85,002	862,596	1,237,342	11,889,897
1924	82,833	795,477	659,350	4,926,478

COKE-OVEN BY-PRODUCTS

By-products from coke-oven operations in the United States, 1923–24

Product	Produced	Sold	
		Quantity	Value
1923			
Tar, gallons	440,907,109	211,739,469	$9,250,552
Ammonia:			
Sulphate, pounds	915,926,762	884,952,912	25,954,413
Ammonia liquor (NH_3 content)[a], do	58,699,902	57,859,699	5,754,463
Sulphate equivalent of all forms, do	(1,150,726,370)	(1,116,391,708)	31,708,876
Gas:			
Distributed through city mains, M cu. ft.	[b]601,155,293	65,143,515	23,116,578
Used in steel or affiliated plant, do.		200,099,200	22,646,134
Used under boilers, etc., do.		33,740,758	1,820,808
Sold for industrial use, do.		19,458,781	4,025,700
			51,609,220
Light oil and derivatives:			
Crude light oil, gallons	[c]135,647,175	6,539,368	683,545
Benzol, crude, do.	4,503,428	4,348,400	768,486
Benzol, refined, do.	12,364,043	12,375,782	3,070,751
Motor benzol, do.	80,467,883	80,480,326	13,145,833
Toluol, crude, do.	37,777	6,097	978
Toluol, refined, do.	2,847,517	2,628,686	765,052
Solvent naphtha, do.	4,162,178	3,399,904	608,084
Other light oil products, do.	439,253	198,098	10,605
			19,053,334
Naphthalene, crude, pounds	11,872,007	10,047,427	174,216
Naphthalene, refined, do.	1,139,922	1,198,206	65,483
			239,699
Other products			214,264
			[d]112,075,945

[a] Includes an unknown quantity of sulphate sold on basis of NH_3 content.
[b] Inclusive of gas wasted and gas used for heating retorts.
[c] Of the crude light oil 132,517,389 gallons was refined on the premises to make the derived products listed.
[d] Exclusive of value of coke breeze.

By-products from coke-oven operations in the United States, 1923–24—Continued

Product		Produced	Sold	
			Quantity	Value
1924				
Tar	gallons	422,074,326	209,979,999	$9,623,520
Ammonia:				
Sulphate	pounds	893,127,071	931,329,570	22,522,248
Ammonia liquor (NH_3 content)	do	49,029,524	47,665,811	4,656,428
Sulphate equivalent of all forms	do	(1,089,245,167)	(1,121,992,814)	27,178,676
Gas:				
Distributed through city mains	M cu. ft.	[b] 541,101,050	65,676,867	23,486,416
Used in steel or affiliated plant	do		187,171,883	[c] 21,007,607
Used under boilers, etc	do		29,794,046	1,729,013
Sold for industrial use	do		18,561,057	3,561,911
				49,784,947
Light oil and derivatives:				
Crude light oil	gallons	[c] 128,956,955	7,840,582	652,467
Benzol (crude	do	3,856,908	3,860,408	831,419
Benzol (refined	do	14,278,117	13,880,200	2,905,237
Motor benzol	do	73,768,811	72,921,224	11,066,652
Toluol (crude	do	234,244	245,079	51,041
Toluol (refined	do	2,951,187	2,986,423	718,641
Solvent naphtha	do	4,474,220	3,884,585	724,874
Other light-oil products	do	1,364,528	1,077,842	78,934
				17,029,265
Naphthalene (crude	pounds	8,378,666	7,891,116	116,305
Naphthalene (refined	do	13,302	327,957	11,903
				128,208
Other products				57,891
				[d] 103,802,507

[b] Inclusive of gas wasted and used for heating retorts.
[c] Of the crude light oil 125,580,743 gallons was refined on the premises to make the derived products listed.
[d] Exclusive of value of coke breeze.

COPPER

SUMMARY OF STATISTICS

Summary of statistics of the copper industry in the United States, 1922–1924

	1922	1923	1924
Production of copper:			
Smelter output (pounds)	950,285,947	1,434,999,962	1,634,249,192
Mine production (do)	964,583,894	1,477,739,709	1,606,165,018
Refinery production of new copper—			
Electrolytic (do)	766,944,836	1,302,454,492	1,499,223,447
Lake (do)	122,545,126	137,691,306	145,333,227
Casting and pig (do)	15,180,723	24,019,197	29,657,925
Total domestic (do)	904,670,685	1,464,164,995	1,674,214,599
Total domestic and foreign (do)	1,255,515,959	1,979,835,616	2,260,076,010
Total new and old copper (do)	1,927,000,000	2,802,000,000	3,037,000,000
Ore produced:			
Copper ore (short tons)	26,893,247	45,519,317	49,178,315
Average yield of copper (per cent)	1.74	1.58	1.59
Copper-lead and copper-zinc ores (short tons)	52,370	162,181	219,874
Average price per pound (cents)	13.5	14.7	13.1
General imports (unmanufactured) (pounds)	541,013,220	676,473,338	768,813,731
Exports of metallic copper [a] (do)	742,755,957	828,854,827	1,116,775,136
Withdrawn from total supply on domestic account:			
Total new copper (pounds)	896,633,833	1,300,473,331	1,354,742,564
Total new and old copper (do)	1,568,000,000	2,122,000,000	2,131,000,000
Stocks at end of year:			
Refined copper (do)	216,000,000	264,000,000	243,000,000
Blister and materials in solution (do)	361,000,000	432,000,000	393,000,000
World's production (do)	1,870,747,000	2,710,653,000	2,945,423,000
Value of smelter production from domestic ores	$128,289,000	$210,945,000	$214,087,000

[a] Total exports of copper, exclusive of ore, concentrates, and composition metal, and, in 1923 and 1924, of a small quantity of unrefined black blister for which figures are not separable from those for ore and concentrates.

PRODUCTION

Copper produced in the United States from domestic ores, 1921–1924

[Smelter output, in pounds fine]

State	1921	1922	1923	1924
Alaska	76,808,114	59,900,579	68,648,368	77,053,492
Arizona	155,165,656	428,200,634	615,493,561	672,365,115
California	15,906,883	20,440,430	27,042,835	49,433,716
Colorado	6,592,598	3,635,916	4,343,418	4,158,612
Georgia		8,147		
Idaho	1,971,623	3,504,944	3,664,079	3,148,519
Maine	3			
Michigan	100,918,001	122,545,126	137,691,306	145,333,227
Missouri	137,591	1,070,259	217,449	184,947
Montana	49,471,206	165,341,414	224,353,764	249,322,394
Nevada	15,129,116	20,398,611	63,495,928	77,281,479
New Mexico	18,076,909	29,127,329	57,521,171	78,145,629
North Carolina			61,913	
Oregon	274,934	925,954	1,182,437	716,656
Pennsylvania		888,721	1,121,573	1,263,535
South Dakota			47	4,199
Tennessee	15,084,294	14,226,232	18,721,932	18,251,996
Texas	587	3,889	4,216	302
Utah	45,831,959	79,665,563	210,118,291	256,531,349
Washington	598,658	369,133	839,254	978,647
Wyoming	9,830		87,686	
Undistributed	3,608,136	33,066	390,734	75,378
	505,586,098	950,285,947	1,434,999,962	1,634,249,192

Primary and secondary copper produced by regular refining plants in the United States and imported, 1921–1924, in pounds

	1921	1922	1923	1924
Primary:				
Domestic[a]—				
Electrolytic	506,532,984	766,944,836	1,302,454,492	1,499,223,447
Lake	100,918,001	122,545,126	137,691,306	145,333,227
Casting	1,740,393	15,180,723	24,019,197	29,657,925
Pig and best select	222,878			
	609,414,256	904,670,685	1,464,164,995	1,674,214,599
Foreign[a]—				
Electrolytic	336,088,209	345,641,677	509,873,512	577,100,034
Casting and best select	5,275,350	5,203,597	5,797,109	8,761,377
Total refinery production of new copper	950,777,815	1,255,515,959	1,979,835,616	2,260,076,010
Imports of refined copper	69,249,281	103,143,142	[b] 160,711,227	145,909,968
Total new refined copper made available	1,020,027,096	1,358,659,101	2,140,546,843	2,405,985,978
Secondary:				
Electrolytic	82,017,382	100,792,685	85,297,052	104,281,430
Casting	24,467,951	45,217,857	46,141,409	50,536,678
	106,485,333	146,010,542	131,438,461	154,818,108
	1,126,512,429	1,504,669,643	2,271,985,304	2,560,804,086

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[b] Figures of imports of refined copper from Chile, as reported by the Chile Exploration Co., have been included here in place of those of the Bureau of Foreign and Domestic Commerce for Chile, which are undoubtedly very low.

In addition to their output of metallic copper the regular refining companies produced in 1924 bluestone having a copper content of 5,766,000 pounds, as compared with 7,987,000 pounds in 1923.

STOCKS

Stocks of copper in the United States, January 1, 1920–1925, in pounds

Year	Refined copper	Blister and material in process of refining	Year	Refined copper	Blister and material in process of refining
1920	631,000,000	273,000,000	1923	216,000,000	361,000,000
1921	659,000,000	465,000,000	1924	264,000,000	432,000,000
1922	459,000,000	283,000,000	1925	243,000,000	393,000,000

CONSUMPTION

New refined copper withdrawn from total year's supply on domestic account in the United States, 1921–1924, in pounds

	1921	1922	1923	1924
Total supply of new copper	1,020,027,096	1,358,659,101	2,140,546,843	2,405,985,978
Stocks at beginning of year	659,000,000	459,000,000	216,000,000	264,000,000
Total available supply	1,679,027,096	1,817,659,101	2,356,546,843	2,669,985,978
Copper exported [a]	609,038,352	705,025,268	[b] 792,073,512	[b] 1,072,243,414
Stocks at end of year	459,000,000	216,000,000	264,000,000	243,000,000
	1,068,038,352	921,025,268	1,056,073,512	1,315,243,414
Withdrawn on domestic account	610,988,744	896,633,833	1,300,473,331	1,354,742,564

[a] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.

[b] Exclusive of small quantity of unrefined black blister for which figures are not separable from those for ore and concentrates.

IMPORTS AND EXPORTS

Copper (in unmanufactured form) imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	437,570,497	$88,751,115	1922	542,932,525	$65,786,811
1920	480,297,985	88,782,609	1923	671,929,223	95,398,681
1921	350,582,746	45,660,326	1924	765,685,592	95,608,460

Copper (unmanufactured) imported into the United States, 1923–24, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black copper and copper in bars, pigs, or other forms	Refined in bars, plates, rods, or other forms	Old and clippings for remanufacture	Composition metal, copper chief value
1923							
Africa:							
British South	9,525	33,174					
Portuguese—							
East	64,908			17,187,927			
Other				53,031,418	380,120		
Australia	107,246			2,872,973			
Bolivia	62			2,151,357	163,229		
Canada	19,374,037	279,003	2,192,826	42,514,549	1,054,078	1,771,377	373,787
Chile	45,044,926	22,982		106,077,067	118,446,874	176,641	2,232,393
Cuba	9,735,954	13,666,280	5,060	1,645		737,748	12,135
France	336,978	6,097	33,500	2,813,867	3,786,859	34,026	
Germany	1,299,725		1,473	1,215,413		332,797	89,313
Mexico	2,319,922	34,362,617		82,161,843		65,470	
Peru	1,182,890	229,795		77,893,297	113,268	13,300	
Spain	7,494,217	482,688		4,160,761	2,905,493		
United Kingdom	102,398	200,485	46,563	556,959	1,617,790	1,904,531	1,492,817
Venezuela	1,450,886	351,254				220	
Other	1,629,029	306,380	681,427	2,624,208	246	449,239	1,996
	90,152,703	49,940,755	2,960,849	395,263,284	128,467,957	5,485,349	4,202,441
Total value	$11,735,291	$6,861,987	$408,666	$56,563,515	$19,119,537	$606,485	$599,993
1924							
Africa:							
British South				672,560			
Portuguese—							
East	70,378			34,330,735			
Other				90,487,936			
Australia				1,234,050			
Bolivia	262,167						
Canada	27,350,280	1,396,411	35,468	51,121,265	1,109,769	2,328,947	150,161
Chile	46,584,230	1,352,352	145,030	124,283,121	141,247,852	35,840	
Cuba	11,969,920	11,429,580				521,909	
France	592,511	6,048	13,642	3,376,036	633,645	9,588	1,312
Germany		37,318	21,159	44,990	17,200	59,043	14,862
Mexico	2,987,404	22,687,382	48,500	69,963,716	477,252	10,317	
Peru	1,731,222	46,185	13,222	74,951,579		5,946	
Spain	10,312,123	284,785		16,505,918			
United Kingdom	155,647	922,254	497,101	2,812,324	2,409,884	128,373	21,180
Venezuela		1,908,480					
Other	3,150,336	1,666,461	279,356	1,244,604	14,366	609,107	21,392
	105,166,218	41,737,256	1,053,478	471,028,834	145,909,968	3,709,070	208,907
Total value	$12,807,225	$4,693,029	$125,288	$59,462,150	$18,556,174	$402,260	$43,170

Copper exported from the United States, 1920–1924

Year	Pounds		Total value
	Metallic [a]	Total	
1920	623,158,489	624,053,701	$127,468,606
1921	628,415,714	628,804,750	85,351,928
1922	742,755,957	743,039,888	103,874,007
1923	828,854,827	829,314,002	129,219,975
1924	1,116,775,136	1,116,915,484	156,645,684

[a] Exclusive of ore, concentrates, and composition metal, and, in 1923 and 1924, of a small quantity of unrefined black blister for which figures are not separable from those for ore and concentrates.

Copper exported from the United States, 1923–24

	1923		1924	
	Pounds	Value	Pounds	Value
Ore, concentrates, matte, and regulus (copper content)	339, 212	$41, 775	55, 545	$8, 569
Unrefined black blister and converter copper (bars, pigs, and other forms)				
Refined in ingots, bars, or other forms	729, 380, 207	110, 489, 142	1, 009, 624, 992	138, 298, 411
Rods	62, 693, 305	9, 994, 654	62, 618, 422	8, 965, 352
Composition metal, copper chief value	119, 963	27, 368	84, 803	19, 971
Old and scrap	3, 544, 545	478, 695	5, 194, 052	566, 163
Pipes and tubes	2, 613, 393	720, 212	2, 649, 816	672, 451
Plates and sheets	4, 535, 743	1, 061, 787	6, 772, 650	1, 331, 537
Wire (except insulated)	9, 842, 992	1, 972, 800	9, 743, 541	1, 701, 656
Insulated wire and cable	11, 681, 450	3, 140, 027	15, 471, 458	3, 895, 763
Other manufactures of copper	4, 563, 192	1, 293, 515	4, 700, 205	1, 185, 811
	829, 314, 002	129, 219, 975	1, 116, 915, 484	156, 645, 684

PRICES

[See statement on page 15A]

CORUNDUM

[See Abrasive materials]

CRYOLITE

PRODUCTION

No natural cryolite is produced in the United States, the entire supply used in this country being imported from Greenland. Artificial cryolite is produced by electrochemical processes.

IMPORTS

Cryolite imported for consumption in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	2, 131	$106, 956	1922	3, 899	$196, 302
1920	3, 864	193, 638	1923	6, 375	319, 959
1921	3, 460	295, 186	1924	6, 320	320, 670

DIATOMACEOUS (INFUSORIAL) EARTH

[See Abrasive materials]

EMERY

[See Abrasive materials]

FELDSPAR

PRODUCTION

Crude feldspar, produced in the United States, sold in 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	63, 441	$347, 992	1922	117, 127	$844, 568
1920	135, 551	851, 123	1923	145, 004	1, 057, 595
1921	91, 865	617, 652	1924	204, 772	1, 509, 339

IMPORTS

The foreign trade of the United States in feldspar is small and limited largely to importing from Canada. Imports have been as follows: 1924, 35,139 long tons of crude feldspar, valued at $284,716; 1923, 24,271 tons, $184,924. Prior to September 22, 1922, imports of feldspar were not specifically classified in the official records and are therefore unknown. From that date to the end of the year the imports amounted to 7,549 long tons of crude, valued at $60,111, and 37 long tons of crushed or ground, valued at $538.

There is no record of exports of feldspar, and if any is exported the quantity is doubtless negligible.

FERROALLOYS

PRODUCTION

Ferroalloys shipped from furnaces in the United States, 1920-1924, in long tons

Year	Ferro-manganese	Spiegel-eisen	Other varieties	Total	
				Quantity	Value
1920	276,594	103,672	232,542	612,808	$77,519,367
1921	111,374	69,230	68,023	248,627	21,697,785
1922	161,612	70,253	191,415	423,280	28,259,004
1923	226,365	134,086	219,366	579,817	49,877,231
1924	232,821	76,179	188,244	497,244	43,249,948

Ferroalloys shipped from furnaces in the United States, 1923–24

Variety of alloy	1923		1924	
	Long tons	Value	Long tons	Value
Ferromanganese	226,365	$23,853,313	[a] 232,821	[a] $23,533,668
Spiegeleisen	134,086	4,547,113	76,179	2,354,731
Ferrosilicon (7 per cent or more silicon)	184,067	9,940,772	150,021	7,558,984
Ferromolybdenum	118	297,842	107	254,970
Ferrotungsten	1,485	2,177,685	741	1,110,553
Ferrovanadium	1,432	3,765,344	1,355	3,641,724
Other varieties [b]	32,264	5,295,162	36,020	4,795,318
	579,817	49,877,231	497,244	43,249,948

[a] Includes small quantity of silico-manganese.

[b] Ferrocarbide, ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon.

IMPORTS AND EXPORTS

Ferroalloys imported for consumption in the United States, 1923–24

Variety of alloy	1923		1924	
	Long tons	Value	Long tons	Value
Ferromanganese (manganese content)	91,066	$8,357,023	45,270	$3,844,474
Spiegeleisen	4,668	165,791	7,433	235,566
Chrome or chromium and ferrochromium	1,481	281,279	468	123,786
Ferrosilicon (silicon content)	11,544	1,044,221	12,125	1,249,071
Molybdenum and ferromolybdenum (molybdenum content)	(a)	5	(b)	802
Titanium and ferrotitanium	6	2,949	13	5,927
Tungsten and ferrotungsten (tungsten content)	35	28,165	63	49,394
		9,879,433		5,509,020

[a] 4 pounds. [b] 431 pounds.

Ferroalloys exported from the United States, 1923–24

Variety of alloy	1923		1924	
	Long tons	Value	Long tons	Value
Ferromanganese	4,295	$151,224	3,165	$92,421
Spiegeleisen				
Ferrosilicon	814	31,154	775	29,214
Tungsten and ferrotungsten	[a] 2	[a] 122,906	[a] 2	[a] 114,775
Ferrovanadium	23	64,713	25	81,016

[a] Includes also tungsten wire.

FLUORSPAR

PRODUCTION

Fluorspar shipped from mines in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	138,290	$3,525,574	1922	141,596	$2,531,165
1920	186,778	4,718,547	1923	121,188	2,505,819
1921	34,960	724,094	1924	124,979	2,451,131

Fluorspar shipped from mines in the United States, 1923–24, by States

State	1923		1924	
	Short tons	Value	Short tons	Value
Colorado	6,044	$59,710	12,301	$135,411
Illinois	65,045	1,443,490	62,067	1,288,310
Kentucky	45,441	945,402	47,847	988,940
New Hampshire	142	3,160		
New Mexico	4,328	50,861	2,580	35,178
Utah	188	3,196	184	3,292
	121,188	2,505,819	124,979	2,451,131

IMPORTS AND EXPORTS

Fluorspar imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	6,943	$107,631	1922	33,108	$299,188
1920	24,612	265,630	1923	41,884	429,696
1921	6,229	69,306	1924	50,821	551,842

No exports of fluorspar have been reported by the Bureau of Foreign and Domestic Commerce. Producers reported 2,764 tons, valued at $65,475, exported in 1920; 2,296 tons, $40,966, in 1922; 1,144 tons, $25,312, in 1923; and 617 tons, $14,489, in 1924.

FULLER'S EARTH

PRODUCTION

Fuller's earth, produced in the United States, sold in 1919–1924

Year	Number of operators	Short tons	Value	Year	Number of operators	Short tons	Value
1919	10	106,145	$1,998,829	1922	15	138,944	$2,289,719
1920	12	128,487	2,506,189	1923	15	149,134	2,247,523
1921	12	105,609	1,973,848	1924	13	177,994	2,632,342

IMPORTS

Fuller's earth imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	13,873	$189,711	1922	10,569	$135,695
1920	19,015	221,893	1923	8,547	113,944
1921	9,744	119,415	1924	7,302	92,488

Exports of fuller's earth are not reported separately.

GARNET (ABRASIVE)

[See Abrasive materials]

GAS (NATURAL)

Natural gas produced in the United States and delivered to consumers, 1919–1924

[Value is at point of consumption]

Year	M cubic feet	Value	Year	M cubic feet	Value
1919	745,916,000	$160,888,000	1922	762,546,000	$221,535,000
1920	798,210,000	196,194,000	1923	1,006,976,000	240,001,000
1921	662,052,000	174,617,000	1924	1,141,521,000	253,856,000

Natural gas produced in the United States and delivered to consumers, 1923–24, by States

[Value is at point of consumption]

State	1923		1924	
	M cubic feet	Value	M cubic feet	Value
Arkansas	24,215,000	$3,255,000	36,616,000	$4,908,000
California	131,434,000	22,787,000	189,692,000	35,949,000
Colorado	800	400	47,600	1,700
Illinois	4,049,000	690,000	4,072,000	759,000
Indiana	880,000	460,000	998,000	494,000
Kansas	30,913,000	11,249,000	25,580,000	10,087,000
Kentucky	11,953,000	3,156,000	12,875,000	3,432,000
Louisiana	112,031,000	6,022,000	160,945,000	7,626,000
Michigan	700	320	600	300
Missouri	17,000	14,000	71,000	61,000
Montana	1,470,000	317,000	1,071,000	272,350
New York	6,497,000	3,739,000	6,196,000	3,632,000
Ohio	53,812,000	25,675,000	47,396,000	24,203,000
Oklahoma	203,082,000	31,214,000	214,452,000	31,045,700
Pennsylvania	112,562,000	45,873,000	105,863,000	45,546,000
South Dakota	33,000	16,600	3,000	2,500
Tennessee	4,100	1,000	1,200	450
Texas	74,535,000	11,320,000	107,247,000	13,748,000
West Virginia	203,867,000	69,981,000	182,285,000	68,000,000
Wyoming	35,523,000	4,222,000	46,036,000	4,081,000
Other [a]	97,400	8,680	73,600	7,000
	1,006,976,000	240,001,000	1,141,521,000	253,856,000

[a] 1923: Alaska, Iowa, New Mexico, and North Dakota; 1924: Alaska, Iowa, and North Dakota.

GASOLINE FROM NATURAL GAS

Natural-gas gasoline produced in the United States, 1920–1924

Year	Raw (unblended) gasoline produced		Natural gas treated (estimate) (M cubic feet)
	Gallons	Value at plant	
1920	384,743,922	$71,788,122	496,431,000
1921	449,934,402	61,815,258	465,097,000
1922	505,832,000	72,711,063	545,139,000
1923	816,226,000	77,268,000	875,711,000
1924	933,861,000	82,233,000	1,016,276,000

Natural-gas gasoline produced in the United States, 1923–24, by States

State	1923		1924	
	Gallons	Value	Gallons	Value
Arkansas	16,183,000	$1,916,000	17,533,000	$1,784,000
California	173,329,000	16,564,000	232,579,000	22,690,000
Illinois	7,356,000	851,000	9,091,000	795,000
Kansas	8,775,000	690,000	11,658,000	913,000
Kentucky	7,601,000	1,067,000	7,274,000	769,000
Louisiana	40,720,000	3,484,000	48,098,000	3,887,000
New York	408,000	44,000	477,000	50,600
Ohio	10,035,000	1,446,000	9,443,000	1,148,000
Oklahoma	270,249,000	23,012,000	301,062,000	23,338,000
Pennsylvania	19,132,000	2,560,000	19,254,000	2,266,000
Texas	177,765,000	14,752,000	186,571,000	14,460,000
West Virginia	63,381,000	8,890,000	61,549,000	7,154,000
Wyoming	21,292,000	1,992,000	29,272,000	2,979,000
	816,226,000	77,268,000	933,861,000	82,233,000

GOLD AND SILVER

PRODUCTION

Gold and silver produced in the United States, 1920–1924

Year	Gold		Silver	
	Troy ounces	Value	Troy ounces	Commercial value
1920	2,476,166	$51,186,900	55,361,573	$60,801,955
1921	2,422.006	50,067,300	53,052,441	53,052,441
1922	2,363,075	48,849,100	56,240,048	56,240,048
1923	2,502,632	51,734,000	73,335,170	60,134,839
1924	2,528,900	52,277,000	65,407,186	43,822,814

Gold produced in the United States, 1923–24, by States [a]

State	1923		1924	
	Troy ounces	Value [b]	Troy ounces	Value [b]
Alaska	314,960	$6,510,800	303,553	$6,275,000
Arizona	296,437	6,127,900	226,385	4,679,800
California	651,369	13,465,000	633,021	13,085,700
Colorado	315,686	6,525,800	420,858	8,699,900
Georgia	34	700	24	500
Idaho	35,764	739,300	27,085	559,900
Montana	85,145	1,760,100	95,815	1,980,700
Nevada	198,415	4,101,600	219,976	4,547,300
New Mexico	23,728	490,500	26,742	552,800
North Carolina	53	1,100	97	2,000
Oregon	23,631	488,500	27,622	571,000
Pennsylvania	131	2,700	213	4,400
Philippine Islands	76,137	1,573,900	82,562	1,706,700
Porto Rico	5	100	10	200
South Carolina	14	300		
South Dakota	307,012	6,346,500	297,085	6,141,300
Tennessee	319	6,600	329	6,800
Texas	44	900		
Utah	156,991	3,245,300	153,378	3,170,600
Virginia			5	100
Washington	16,733	345,900	14,130	292,100
Wyoming	24	500	10	200
	2,502,632	51,734,000	2,528,900	52,277,000

[a] Figures furnished by the Bureau of the Mint. [b] Gold value, $20.67+ a troy ounce.

Silver produced in the United States, 1923–24, by States [a]

State	1923		1924	
	Troy ounces	Value [b]	Troy ounces	Value [c]
Alaska	816,177	$669,265	690,781	$462,823
Arizona	7,376,832	6,049,002	6,390,684	4,281,758
California	3,689,856	3,025,682	3,598,733	2,411,153
Colorado	5,529,121	4,533,879	3,549,903	2,378,435
Idaho	8,019,977	6,576,381	8,036,358	5,384,359
Illinois	10,175	8,343	9,500	6,365
Michigan	253,705	208,038	155,372	104,099
Missouri	167,452	137,311	86,201	57,754
Montana	14,226,272	11,665,543	13,688,728	9,171,447
Nevada	10,640,656	8,725,338	9,333,197	6,253,242
New Mexico	737,863	605,048	834,933	559,405
North Carolina	79	65	24	16
Oregon	75,583	61,978	45,143	30,246
Pennsylvania	1,278	1,048	2,800	1,876
Philippine Islands	39,360	32,275	40,346	27,032
Porto Rico	184	151	11	7
South Dakota	95,822	78,574	89,417	59,909
Tennessee	109,086	89,450	95,542	64,013
Texas	825,267	676,719	718,425	481,345
Utah	20,479,550	16,793,231	17,821,716	11,940,551
Washington	240,712	197,384	219,372	146,979
Wyoming	163	134		
	73,335,170	60,134,839	65,407,186	43,822,814

[a] Figures furnished by the Bureau of the Mint.
[b] Valued at 82 cents an ounce—average of Pittman Act price ($1 an ounce) January to June and New York price July to December.
[c] Valued at average New York price of bar silver—67 cents an ounce.

IMPORTS AND EXPORTS

Value of gold and silver imported into and exported from the United States, 1920–1924

Year	Gold		Silver	
	Imports	Exports	Imports	Exports
1920	$417,068,273	$322,091,208	$88,060,041	$113,616,224
1921	691,248,297	23,891,377	63,242,671	51,575,399
1922	275,169,785	36,874,894	70,806,653	62,807,286
1923	322,715,812	28,643,417	74,453,530	72,468,789
1924	319,720,918	61,648,313	73,944,902	109,891,033

Value of gold and silver imported into and exported from the United States, 1923–24, by classes

	Imports	Exports	Excess of—	
			Imports	Exports
1923				
Gold:				
Contained in domestic ore and base bullion		$248,771		$248,771
Contained in foreign ore and base bullion	$24,048,777		$24,048,777	
Domestic bullion refined		19,769,016		19,769,016
Foreign bullion refined	186,123,382	66	186,123,316	
United States coin	37,488,237	7,848,658	29,639,579	
Foreign coin	75,055,416	776,906	74,278,510	
	322,715,812	28,643,417	314,090,182	20,017,787
Excess imports over exports			294,072,395	
Silver:				
Contained in domestic ore and base bullion		45,225		45,225
Contained in foreign ore and base bullion	40,342,858		40,342,858	
Domestic bullion refined		40,127,961		40,127,961
Foreign bullion refined	31,249,574	28,935,369	2,314,205	
United States coin	841,655	214,012	627,643	
Foreign coin	2,019,443	3,146,222		1,126,779
	74,453,530	72,468,789	43,284,706	41,299,965
Excess imports over exports			1,984,741	
1924				
Gold:				
Contained in domestic ore and base bullion		245,817		245,817
Contained in foreign ore and base bullion	22,589,649		22,589,649	
Domestic bullion refined		26,838,091		26,838,091
Foreign bullion refined	196,009,351	21	196,009,330	
United States coin	29,213,499	33,225,446		4,011,947
Foreign coin	71,908,419	1,338,938	70,569,481	
	319,720,918	61,648,313	289,168,460	31,095,855
Excess imports over exports			258,072,605	
Silver:				
Contained in domestic ore and base bullion		28,650		28,650
Contained in foreign ore and base bullion	38,919,408		38,919,408	
Domestic bullion refined		90,851,274		90,851,274
Foreign bullion refined	33,441,610	14,225,232	19,216,378	
United States coin	683,023	280,465	402,558	
Foreign coin	900,861	4,505,412		3,604,551
	73,944,902	109,891,033	58,538,344	94,484,475
Excess exports over imports				35,946,131

PRICES

Gold is valued by law at $20.67+ a troy ounce. For prices of silver, see statement on page 15A.

GRAPHITE

PRODUCTION

Natural graphite sold by producers in the United States, 1920–1924

Year	Amorphous		Crystalline	
	Short tons	Value	Pounds	Value
1920	4,694	$49,758	9,632,360	$576,444
1921	1,842	20,860	1,189,523	75,664
1922	2,200	(a)	1,849,766	85,242
1923	4,056	39,560	3,964,900	151,434
1924	4,071	38,533	1,800,325	48,977

[a] Bureau of Mines not at liberty to publish value.

Graphite is manufactured by the Acheson Graphite Co. at Niagara Falls, N. Y. The figures given below are published by permission of this company.

Graphite manufactured by the Acheson Graphite Co., 1919–1924, in pounds

1919	8,163,177	1922	13,031,926
1920	7,399,749	1923	26,761,015
1921	5,888,000	1924	10,986,192

IMPORTS AND EXPORTS

Graphite imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports		
	Short tons	Value	Unmanufactured		Manufactures of
			Short tons	Value	
1920	21,095	$1,711,312	607	$112,771	$610,261
1921	8,183	452,076	921	95,998	679,359
1922	12,488	473,046	569	78,094	[a] 255,019
1923	[b] 19,434	[b] 614,119	908	138,542	[a] 335,778
1924	[b] 16,375	[b] 399,511	1,022	144,108	[a] 250,957

[a] Exclusive of crucibles, figures for which are not available.
[b] Composed of the following: 1923, "amorphous" 11,252 tons, $149,831; "crystalline chip or dust" 7,243 tons, $426,417; and "crystalline flake" 939 tons, $37,871; 1924, 10,936 tons, $113,751; 3,998 tons, $197,867; and 1,441 tons, $87,893, respectively. Classes not separately shown for earlier years.

GRINDSTONES AND PULPSTONES

[See Abrasive materials]

GYPSUM

PRODUCTION

Gypsum produced and sold in the United States, 1919–1924

Year	Crude produced (short tons)	Crude and calcined sold (total value)	Year	Crude produced (short tons)	Crude and calcined sold (total value)
1919	2,420,163	$15,727,907	1922	3,779,949	$29,361,151
1920	3,129,142	24,533,065	1923	4,753,448	34,888,155
1921	2,890,784	23,700,290	1924	5,042,629	42,724,507

IMPORTS AND EXPORTS

Gypsum imported for consumption in the United States, 1920–1924

Year	Crude		Ground or calcined		Value of manufactured plaster of Paris	Keene's cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1920	282,486	$397,942	14,921	$179,191	$10,282	202	$5,338	$592,753
1921	266,796	364,318	4,495	55,109	33,072	184	6,836	459,335
1922	409,475	523,939	1,774	32,651	55,116	403	9,636	621,34
1923	448,129	629,203	5,133	77,716	41,317	418	11,543	759,779
1924	519,627	724,864	5,217	70,793	48,059	539	12,042	855,758

Exports of gypsum are designated as "gypsum or plaster, crude, ground, calcined, and manufactures of," and have been as follows: 1924, 10,623 short tons, valued at $358,425; 1923, 8,815 tons, $226,423; 1922, 7,673 tons, $178,166. Exports are not separately classified for earlier years.

ILMENITE

[See Titanium minerals]

IRON ORE, PIG IRON, AND STEEL

IRON ORE

[Exclusive of all domestic ore containing 5 per cent or more of manganese. For data regarding such ore, see Manganese]

PRODUCTION

Iron ore mined in the United States, 1920–1924, by varieties, in long tons

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1920	[a] [b] 63,883,523	[b] 1,325,661	[a] 2,391,541	3,740	67,604,465
1921	[a] [b] 28,337,249	[b] 370,154	[a] 780,866	2,709	29,490,978
1922	[b] 44,888,723	[b] 783,582	1,452,966	3,256	47,128,527
1923	[b] 65,924,454	[b] 1,232,848	2,190,624	3,516	69,351,442
1924	[b] 52,102,300	[b] 814,159	1,347,711	3,249	54,267,419

[a] Some magnetite included with hematite.
[b] Some hematite included with brown ore.

Iron ore mined in the United States, 1923–24 by mining districts and varieties, in long tons

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1923					
Lake Superior [a]	59,196,734		88,674		59,285,408
Birmingham	5,740,233	306,675			6,046,908
Chattanooga	404,948	229,102			634,050
Adirondack			460,311		460,311
Northern New Jersey and southeastern New York			376,495		376,495
Other districts	[b] 582,539	[b] 697,071	1,265,144	3,516	2,548,270
	[b] 65,924,454	[b] 1,232,848	2,190,624	3,516	69,351,442
1924					
Lake Superior [a]	44,796,766		44,953		44,841,719
Birmingham	6,214,381	296,931			6,511,312
Chattanooga	376,693	171,004			547,697
Adirondack			197,437		197,437
Northern New Jersey and southeastern New York			110,626		110,626
Other districts	[b] 714,460	[b] 346,224	994,695	3,249	2,058,628
	[b] 52,102,300	[b] 814,159	1,347,711	3,249	54,267,419

[a] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[b] Some hematite included with brown ore.

Iron ore mined in the Lake Superior district, 1920–1924, by ranges, in long tons

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530
1921	2,204,114	2,147,569	3,135,477	981,576	16,380,190	449,559	25,298,485
1922	2,745,626	3,290,641	4,910,789	1,108,764	26,704,601	955,595	39,716,016
1923	3,910,909	4,913,541	6,112,662	1,119,113	41,809,018	1,420,165	59,285,408
1924	3,579,087	3,780,664	5,579,883	1,141,690	29,818,965	941,430	44,841,719

Iron ore shipped from mines in the United States, 1919–1924

[Exclusive of ore sold for paint. See p. 59A]

Year	Long tons	Value	Year	Long tons	Value
1919	56,372,784	$197,312,517	1922	50,612,620	$157,809,286
1920	69,281,341	285,006,327	1923	69,811,472	240,738,921
1921	26,652,528	89,745,308	1924	52,083,375	151,307,105

Iron ore shipped from mines in the United States, 1923–24, by States

[Exclusive of ore sold for paint. See p. 59A]

State	1923		1924	
	Long tons	Value	Long tons	Value
Alabama	6,922,663	$15,540,198	6,557,596	$13,927,551
California	2,769	18,665	435	[a]
Colorado	4,102	[a]	4,702	[a]
Georgia	117,286	300,712	112,059	285,128
Idaho	1,290	[a]		
Michigan	14,065,561	54,110,070	11,248,641	35,605,902
Minnesota	44,556,053	158,402,788	31,076,114	93,311,092
Missouri	54,348	247,975	79,847	405,622
Montana	17,751	51,039	3,913	10,846
Nevada	9,578	[a]		
New Jersey	349,435	1,403,723	101,123	420,488
New Mexico	205,218	[a]	189,371	[a]
New York	722,096	3,242,229	303,386	1,448,616
North Carolina	59,684	161,603	12,525	32,512
Ohio			244	[a]
Pennsylvania	988,586	2,264,485	807,411	1,881,122
Tennessee	266,175	677,753	179,293	431,682
Utah	57,752	205,936	164,154	234,348
Virginia	200,966	664,240	91,759	250,279
Washington			1,700	[a]
Wisconsin	831,412	2,421,194	786,006	2,044,762
Wyoming	378,747	[a]	363,096	[a]
Undistributed		[b] 1,026,311		[b] 1,017,155
	69,811,472	240,738,921	52,083,375	151,307,105

[a] Included under "Undistributed."
[b] This figure includes value for States entered as "(a)" above.

STOCKS

Stocks of iron ore at mines in the United States, December 31, 1923 and 1924, in long tons

State	1923	1924	State	1923	1924
Alabama	304,262	740,279	New York	498,901	441,492
Georgia	155	653	Pennsylvania	4,408	1,200
Iowa	12,165	12,165	Virginia	10,022	6,503
Michigan	6,279,090	7,399,505	Wisconsin	256,319	159,045
Minnesota	2,651,879	3,537,237			
Missouri	3,079	3,079		10,165,875	12,410,619
New Jersey	145,595	109,461			

IMPORTS AND EXPORTS

Iron ore imported into and exported from the United States, 1920–1924

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1920	1,273,456	$4,963,654	1,145,037	$6,198,927
1921	315,768	1,075,909	440,106	2,077,620
1922	1,135,156	4,916,294	602,194	2,770,878
1923	2,768,430	11,308,503	1,116,932	5,305,365
1924	2,047,055	10,580,904	595,413	2,407,003

PIG IRON

PRODUCTION

Pig iron shipped from blast furnaces in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	30,130,231	$775,915,043	1922	27,670,738	$608,144,858
1920	35,710,227	1,140,904,096	1923	38,361,379	946,799,378
1921	16,038,619	389,437,792	1924	31,064,129	665,078,972

Pig iron shipped from blast furnaces in the United States, 1923–24, by States

State	1923		1924	
	Long tons	Value	Long tons	Value
Alabama	2,784,625	$64,912,809	2,667,361	$55,791,228
Colorado	[a]	[a]	[a]	[a]
Illinois	3,741,002	94,878,917	2,695,961	59,299,519
Indiana	3,021,504	70,270,894	2,571,411	52,507,720
Kentucky	154,680	[a]	99,055	[a]
Maryland	489,137	[a]	539,188	[a]
Massachusetts	1,667	[a]	50	[a]
Michigan	717,279	18,827,808	650,333	15,225,990
Minnesota	418,726	[a]	189,033	[a]
Missouri	4,513	[a]	21,371	[a]
New Jersey	[a]	[a]	[a]	[a]
New York	2,426,522	57,543,779	1,914,545	38,150,486
Ohio	8,964,805	222,009,553	7,434,487	159,701,131
Pennsylvania	13,898,624	347,679,274	10,962,288	237,052,035
Tennessee	215,009	5,793,756	126,660	2,782,154
Utah			[a]	[a]
Virginia	238,742	6,389,147	94,462	2,268,022
West Virginia	506,543	12,499,112	453,944	9,884,019
Wisconsin	280,457	7,264,981	172,435	3,945,369
Undistributed	[b] 497,544	[b] 38,729,346	[b] 471,545	[b] 28,471,299
	38,361,379	946,799,378	31,064,129	665,078,972

[a] Included under "Undistributed."
[b] This figure covers States entered as "(a)" above.

IMPORTS AND EXPORTS

Pig iron[a] imported into and exported from the United States, 1920–1924

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1920 [a]	185,944	$12,801,834	216,828	$10,074,377
1921 [a]	44,036	2,014,926	28,307	933,093
1922	383,445	8,670,860	30,920	756,842
1923	367,778	9,005,077	32,318	862,443
1924	209,109	3,741,213	41,483	957,921

[a] Figures for 1920 and 1921 include ferroalloys. Separate data not available prior to 1922.

STEEL

Steel produced in the United States, 1920–1924, in long tons[a]

Year	Bessemer	Open-hearth	Crucible	Other steel	Total
1920	8, 883, 087	32, 671, 895	72, 265	505, 687	42, 132, 934
1921	4, 015, 938	15, 589, 802	7, 613	170, 444	19, 783, 797
1922	5, 919, 298	29, 308, 983	28, 606	346, 039	35, 602, 926
1923	8, 484, 088	35, 899, 657	44, 079	515, 872	44, 943, 696
1924	5, 899, 590	31, 577, 350	22, 473	432, 526	37, 931, 939

[a] According to the American Iron and Steel Institute.

LEAD

PRODUCTION

Refined primary lead produced in the United States from domestic ores, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	424, 433	$44, 990, 000	1922	468, 746	$51, 562, 000
1920	476, 849	76, 296, 000	1923	543, 841	76, 138, 000
1921	398, 222	35, 840, 000	1924	566, 407	90, 625, 000

Refined primary lead produced in the United States, 1920–1924, in short tons

	1920	1921	1922	1923	1924
Domestic ore:					
Desilverized lead	220, 327	187, 962	185, 191	291, 760	299, 343
Soft lead	189, 854	157, 513	209, 250	190, 749	203, 615
Desilverized soft lead	66, 668	52, 747	74, 305	61, 332	63, 449
Total from domestic ore	476, 849	398, 222	468, 746	543, 841	566, 407
Foreign ore:					
Africa	1, 171			99	6
Australia	450				
Canada	1, 186	2, 877	3, 604	3, 632	4, 633
Central America	22	6	14	18	30
Mexico	2, 729	1, 912	7, 260	18, 867	33, 328
South America	2, 747	2, 235	2, 458	1, 461	7, 663
Other foreign	109	90	562	211	725
Foreign base bullion:					
Canada	1, 919	1, 599	2, 900		
Mexico	42, 421	41, 648	47, 118	50, 193	77, 701
South America	54				
Total from foreign ore and base bullion	52, 808	50, 367	63, 916	74, 481	124, 086
Grand total from all sources	529, 657	448, 589	532, 662	618, 322	690, 493
Production of antimonial lead	12, 535	10, 064	8, 075	14, 190	20, 787

Secondary lead recovered in the United States, 1920–1924

Year	Pig lead (short tons)	Lead in alloys (short tons)	Total	
			Short tons	Value
1920	56, 350	68, 300	124, 650	$19, 944, 000
1921	46, 370	57, 410	103, 780	9, 340, 000
1922	75, 480	84, 080	159, 560	17, 552, 000
1923	96, 430	98, 060	194, 490	27, 229, 000
1924	90, 400	114, 100	204, 500	32, 720, 000

IMPORTS AND EXPORTS

Lead imported into the United States in ore, base bullion, and refined, 1920–1924, by sources, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total imports
1920	8,199,234	131,815,278	7,085,351	38,766,504	11,163,160	197,029,527
1921	8,127,158	106,406,238	2,381,365	30,224,701	1,430,949	148,570,411
1922	8,663,236	141,216,136	3,803,478	1,454,384	513,335	155,650,569
1923	11,399,671	242,352,788	5,300,161	11,004,938	520,635	270,578,193
1924	11,022,091	243,161,069	15,820,867	4,857,805	453,432	275,315,264

Lead imported into the United States, 1920–1924, by classes, in pounds

[General imports]

Year	Lead in ore (lead content)	Base bullion		Pigs, bars, sheets, and old	Total lead content
		Gross weight	Lead content		
1920	29,488,816	101,476,550	96,103,603	71,437,108	197,029,527
1921	14,234,039	77,882,834	71,733,838	62,602,534	148,570,411
1922	24,474,481	[a]	124,074,465	7,101,623	155,650,569
1923	66,882,850	[a]	161,496,495	42,198,848	270,578,193
1924	95,320,168	[a]	155,501,350	24,493,746	275,315,264

[a] Figures not available.

Lead imported for consumption in the United States, 1920–1924, by classes

Year	Lead in ore [a]		Base bullion		Pigs, bars, and old [b]		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1920	13,700,499	$908,619	66,816,820	$3,340,600	68,901,959	$3,887,821	81,396	$5,483	$21,328	$8,163,851
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,716	3,087	140	11,204	3,979,516
1922	23,649,851	812,603	55,859,422	1,815,142	8,563,110	335,924	6,018	697	12,286	2,976,652
1923	22,420,046	1,190,414	11,124,151	626,201	42,925,265	2,510,466	19,525	4,495	90,027	4,421,603
1924	65,147,976	3,145,791	28,796,402	1,542,167	27,362,392	1,850,862	11,666	4,384	138,637	6,681,841

[a] Includes also lead in matte beginning Sept. 22, 1922, when new tariff went into effect.
[b] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., beginning Sept. 22, 1922, when new tariff went into effect.

Lead exported from the United States, 1920–1924, by classes

Year	Pigs and bars				Foreign lead used in articles exported with benefit of drawback [a]	Manufactures of lead from both domestic and foreign ores
	From domestic ore		From foreign ore			
	Pounds	Value	Pounds	Value	Pounds	
1920	5,459,713	$462,223	34,725,501	$2,570,535	12,350,794	$3,621,397
1921	3,247,294	177,926	50,000,259	2,284,107	18,738,927	1,376,259
1922	11,645,821	604,605	64,709,305	3,177,360	11,354,070	1,158,150
1923	3,997,485	260,487	97,471,326	5,195,256	25,052,107	1,078,636
1924	10,664,083	711,147	153,515,863	9,685,619	30,549,116	1,965,555

[a] Exclusive of lead that entered as pig and was exported in the same form, which would be duplicated in exports of lead from foreign ore.

PRICES

[See statement on p. 15A]

LIME

PRODUCTION

Lime sold by producers in the United States, 1920–1924

Year	Hydrated			Total		
	Number of plants in operation	Short tons	Value [a]	Number of plants in operation	Short tons	Value [a]
1920	98	853,116	$9,287,562	515	3,570,141	$37,543,840
1921	105	792,970	7,421,037	520	2,532,153	24,895,370
1922	114	1,106,063	9,868,980	530	3,639,617	33,255,039
1923	121	1,225,928	12,229,598	467	4,076,243	39,993,652
1924	119	1,316,664	13,199,846	439	4,072,000	39,596,423

[a] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold by producers in the United States, 1923–24, by States

State	1923			1924		
	Number of plants in operation	Short tons	Value	Number of plants in operation	Short tons	Value
Alabama	12	193,429	$1,627,539	10	204,059	$1,812,282
Arizona	3	18,764	264,683	3	27,972	331,756
Arkansas	3	14,941	136,185	3	13,984	131,108
California	8	66,703	869,979	10	59,583	658,138
Colorado	3	(a)	(a)	4	(a)	(a)
Connecticut	6	59,158	813,254	6	58,851	796,541
Florida	2	(a)	(a)	2	(a)	(a)
Georgia	1	(a)	(a)	1	(a)	(a)
Hawaii	1	(a)	(a)	1	(a)	(a)
Idaho	2	(a)	(a)	1	(a)	(a)
Illinois	11	92,633	978,658	10	89,132	934,199
Indiana	7	126,296	1,151,083	7	116,927	991,003
Iowa	2	(a)	(a)	2	(a)	(a)
Kentucky	1	(a)	(a)	3	8,091	58,228
Maine	4	139,781	1,946,486	4	125,688	1,809,929
Maryland	14	63,858	553,811	11	56,178	470,105
Massachusetts	10	180,720	2,550,575	11	194,402	2,693,028
Michigan	7	59,629	612,369	7	73,096	702,072
Minnesota	4	29,805	339,957	4	25,764	319,066
Missouri	16	246,326	2,505,785	18	243,465	2,354,175
Montana	2	(a)	(a)	3	2,374	25,316
Nevada	1	(a)	(a)	1	(a)	(a)
New Jersey	2	(a)	(a)	3	204	1,516
New Mexico	3	1,859	19,362	3	2,389	23,975
New York	15	100,862	1,037,737	12	98,592	991,799
North Carolina	1	(a)	(a)	1	(a)	(a)
Ohio	31	867,982	8,740,688	21	934,407	9,511,270
Oklahoma	2	(a)	(a)	1	(a)	(a)
Oregon	1	(a)	(a)	2	(a)	(a)
Pennsylvania	143	772,839	6,372,732	136	700,380	5,634,806
Porto Rico	24	6,167	71,014	19	8,264	132,365
Rhode Island	1	(a)	(a)	1	(a)	(a)
South Dakota	2	(a)	(a)	2	(a)	(a)
Tennessee	16	131,995	1,028,158	18	144,292	1,111,781
Texas	9	62,822	606,976	5	60,565	579,334
Utah	11	12,228	152,136	10	12,853	172,434
Vermont	10	58,681	702,588	10	56,484	710,739
Virginia	33	182,604	1,490,306	31	172,776	1,409,447
Washington	6	25,895	359,510	6	28,188	353,450
West Virginia	11	241,601	2,029,061	10	238,714	1,884,682
Wisconsin	25	227,549	2,055,646	25	235,030	2,129,701
Wyoming	1	(a)	(a)	1	(a)	(a)
Undistributed		91,116	977,374		79,296	871,178
	467	4,076,243	39,993,652	439	4,072,000	39,596,423

[a] Included under "Undistributed."

IMPORTS AND EXPORTS

Lime imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	22,688	$392,137	5,921	$128,296
1921	10,811	234,798	5,192	109,769
1922	14,112	290,845	8,289	116,649
1923	25,407	428,903	11,789	170,289
1924	20,480	377,994	14,905	212,340

LITHIUM MINERALS

Lithium minerals produced in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	6,287	$115,000	1922	2,192	$41,300
1920	11,696	173,002	1923	2,310	38,800
1921	1,833	33,508	1924	2,996	62,391

Imports and exports of lithium minerals are not reported separately.

LITHOGRAPHIC STONE

No domestic production of lithographic stone has been reported since 1918.

Lithographic stone imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	464,914	$216,293	1922	256,426	$28,242
1920	786,119	63,733	1923	225,600	24,861
1921	301,546	34,101	1924	133,674	9,046

No exports of lithographic stone are reported.

MAGNESITE

PRODUCTION

Domestic magnesite (expressed as equivalent crude) sold or treated in the United States, 1920–1924

Year	California		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	81,782	$1,083,262	221,985	$1,664,888	303,767	$2,748,150
1921	47,904	510,177	----------	----------	47,904	510,177
1922	[a] 55,790	[a] 571,745	(a)	(a)	55,790	571,745
1923	73,350	938,600	73,900	165,100	147,250	1,103,700
1924	67,240	901,700	52,860	139,600	120,100	1,041,300

[a] Washington included with California. Bureau of Mines not at liberty to publish figures.

IMPORTS

Magnesite imported for consumption in the United States, 1920–1924

Year	Crude		Calcined, not purified	
	Short tons	Value	Short tons	Value
1920	33,550	$406,204	14,780	$373,165
1921	51,993	525,452	6,788	250,932
1922	73,331	976,283	72,265	1,267,622
1923	5,182	44,081	72,955	1,022,968
1924	6	85	64,785	1,172,403

Exports are not separately recorded.

MAGNESIUM

PRODUCTION

Domestic metallic magnesium sold or used in the United States, 1920–1924

Year	Number of producers	Pounds	Value	Average price per pound		
				Ingot (stick)	Powder	Sheet, wire, and castings
1920	2	[a]	[a]	$1.60	$2.75	
1921	1	48,000	$86,000	1.30	2.36	
1922	2	[b] 60,000	[b] 89,000	1.60	1.13	
1923	2	[b] 125,000	[b] 155,000	1.25	1.00	$3.66
1924	2	[b] 128,000	[b] 150,000	[c] 1.07	[d] 1.10	3.50

[a] Bureau of Mines not at liberty to publish figures.
[b] Estimate.
[c] Prices ranged from as low as 90 cents in large contracts to $1.10 for small quantities. The published price established about Mar. 1, 1924, was $1.
[d] This price is an average for old powder sold in competition with old imported stocks and for new powder, manufacture of which began in October, 1924, at a sales price of $1.50 a pound.

IMPORTS

Magnesium imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	13,239	$13,583	1922	182,939	$54,448
1920	29,275	25,055	1923	13.974	11,576
1921	39,913	30,592	1924	8,738	6,561

Exports are not separately recorded.

MANGANESE

PRODUCTION

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1920–1924

State	Ore containing 35 per cent of manganese or more			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value
1923									
Alabama	1	(a)	(a)	4	694	$8,067			
Arizona	1	245	(a)						
Arkansas	8	3,768	$73,507	7	4,773	20,047			
California	2	(a)	(a)						
Colorado	3	2,278	41,203	8	18,348	68,204			
Georgia	5	1,502	23,380	11	14,718	80,135	7	15,530	$43,711
Michigan				1	20,079	80,517	1	204,700	(a)
Minnesota				4	253,634	880,575	3	499,181	1,406,385
Montana	6	21,916	674,509						
New Mexico	3	179	3,693	3	6,759	17,398			
Oklahoma	1	(a)	(a)						
Tennessee	3	213	5,611						
Virginia	3	987	42,020	3	661	3,685			
Wisconsin							1	353,046	(a)
Undistributed		412	11,050						2,148,231
Total, 1923	36	31,560	874,973	41	319,666	1,158,628	12	1,072,457	3,598,327
Total, 1922	18	13,494	455,160	9	344,674	1,071,780	6	251,614	632,039
Total, 1921	14	13,531	495,097	6	8,439	42,755	3	62,670	147,576
Total, 1920	56	94,420	2,396,235	31	357,279	1,450,518	6	279,687	644,572
1924									
Alabama	3	1,242	24,954	9	611	6,722			
Arizona	1	42	798						
Arkansas	6	3,400	60,350	6	7,991	37,170			
California	2	850	(a)						
Colorado	2	5,338	48,042	7	27,058	109,289	1	3,891	(a)
Georgia	8	1,093	18,304	19	14,182	73,684	6	6,353	16,558
Michigan				1	50,556	157,184	1	39,939	(a)
Minnesota				4	159,915	439,132	3	361,527	970,351
Montana	6	35,445	939,919						
Nevada	3	1,310	13,579	3	2,591	15,997			
New Mexico	2	775	(a)	2	23,246	(a)			
Tennessee	2	455	11,611						
Utah				2	116	1,010			
Virginia	3	1,565	59,220	2	204	(a)			
Washington	1	5,000	100,000						
Wisconsin							1	175,316	606,593
Undistributed			30,700			89,202			120,441
Total, 1924	39	56,515	1,307,477	55	286,470	929,390	12	587,026	1,713,943

a Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

Manganese and manganiferous ore (for fluxing purposes) shipped from mines in the United States, 1920–1924

Year	Ore containing 35 per cent of manganese or more		Ore containing 10 to 35 per cent of manganese		Ore containing 5 to 10 per cent of manganese [a]	
	Long tons	Value	Long tons	Value	Long tons	Value
1920			123,970	$332,615	6,728	$10,093
1921			22,962	[b] 57,000	3,028	[b] 7,800
1922	2,278	$17,341	27,705	[b] 52,000	1,666	[b] 10,600
1923	769	(c)	40,770	[b c] 134,133	1,004	[b] 2,510
1924	1,833	(c)	24,972	[b c] 107,215		

a Includes small quantities of ore containing less than 5 per cent of manganese. For such figures see p. 95.
b Partly estimated.
c Value for 35 per cent ore included with that for 10–35 per cent ore. Bureau of Mines not at liberty to publish figures.

Manganiferous silver ore shipped from mines in the United States, 1920–1924, in long tons

Year	Arizona	Colorado	Montana	Nevada	New Mexico
1920	345	45, 726	----------	95, 142	541
1921	----------	11, 743	----------	14, 871	300
1922	----------	13, 951	6, 656	----------	8, 764
1923	----------	28, 724	3, 596	28, 571	----------
1924	----------	35, 437	5, 607	16, 710	----------

Manganiferous iron ore shipped from the Cuyuna district, Minn., 1919–1924, in long tons

Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese
1919	138, 952	98, 220	1922	305, 093	248, 560
1920	293, 524	248, 913	1923	253, 634	499, 181
1921	----------	56, 530	1924	159, 915	361, 527

IMPORTS

Manganese ore [a] imported for consumption in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	333, 344	$11, 229, 184	1922[a] (Jan. 1–Sept. 21	327, 727	$2, 695, 724
1920	606, 937	12, 230, 922	1922[a] (Sept. 22–Dec. 31	[b] 18, 124	364, 247
1921	401, 354	3, 365, 732	1923	[b] 78, 391	1, 674, 914
			1924	[b] 224, 230	5, 305, 791

[a] Prior to Sept. 22, 1922, figures represent ore; beginning with new tariff, figures represent manganese content of ore.

[b] Includes estimate by Bureau of Mines for manganese content of ore imported from Cuba. The Bureau of Foreign and Domestic Commerce records only gross weight of Cuban ore imported, and the figures for such ore have been as follows: 1922 (Sept. 22 to Dec. 31), 190 long tons; 1923, 9,062 tons; 1924, 23,065 tons.

No separate record of exports of manganese ore is kept.

MANGANIFEROUS ZINC RESIDUUM

Manganiferous zinc residuum containing 12 to 15 per cent of manganese and 40 per cent of iron is recovered from roasted franklinite concentrates at Franklin Furnace, N. J. No price is given for this material, as it is not sold in the open market, but is reduced to spiegeleisen by the company that produces it.

Manganiferous residuum, from zinc roasting in the United States, shipped in 1919–1924, in long tons

1919	80, 418	1922	81, 333
1920	133, 602	1923	132, 807
1921	12, 627	1924	119, 451

MARLS

Calcareous marl sold by producers in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	91, 437	$327, 294	1922	67, 777	$203, 196
1920	97, 487	322, 339	1923	99, 410	328, 932
1921	59, 730	195, 743	1924	72, 710	225, 383

Greensand marl produced in the United States, 1921–1924

Year	Short tons	Value
1921	2,058	$10,200
1922	7,885	56,800
1923	10,656	131,123
1924	14,055	151,205

No imports or exports of marl are reported.

MICA

PRODUCTION

Mica sold by producers in the United States, 1920–1924

Year	Sheet mica		Scrap mica		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1920	1,683,480	$546,972	5,723	$167,017	6,565	$713,989
1921	741,845	118,513	2,577	56,849	2,948	175,362
1922	1,077,968	194,301	[a] 6,641	114,045	[a] 7,180	308,346
1923	2,063,179	311,180	[a] 8,054	129,695	[a] 9,086	440,875
1924	1,460,897	212,035	4,709	87,242	5,439	299,277

[a] Includes mica derived from mica schist.

IMPORTS AND EXPORTS

Mica imported for consumption in the United States, 1920–1924

Year	Sheet				Ground		Total	
	Unmanufactured		Cut and splittings					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	1,298,537	$1,177,943	[c]	$2,011,434			[c]	$3,189,377
1921	328,444	331,219	[c]	758,521	134,650	$2,166	[c]	1,091,906
1922	385,653	359,793	[c]	[b] 966,315	313,745	4,514	[c]	1,330,622
1923	1,044,366	532,375	[a] 4,419,102	[a] 1,844,149	1,867,385	28,324	7,330,853	2,404,848
1924	671,793	419,154	[a] 3,787,251	[a] 1,885,718	1,342,107	22,034	5,801,151	2,326,906

[a] Quantity not reported.

[b] Includes also value of "built up, washers, and other manufactures" ($20,899) imported Sept. 22 to Dec. 31. Not separately classified prior to new tariff.

[c] Composed of following: 1923, "Cut mica" 60,135 pounds, $49,268; "splittings" 4,301,727 pounds, $1,730,532; "built up" 30,032 pounds, $37,382; and "washers and other" 27,208 pounds, $26,967; 1924, "Cut mica" 74,534 pounds, $69,018; "splittings" 3,619,229 pounds, $1,681,774; "built up" 18,205 pounds, $41,455; and "washers and other" 75,283 pounds, $93,471.

Value of mica exported from the United States, 1919–1924

1919	$109,348	1922	$129,186
1920	316,169	1923	182,162
1921	153,990	1924	169,741

MILLSTONES

[See Abrasive materials]

MINERAL PAINTS

Domestic zinc and lead pigments,[a] made directly from ores in the United States, sold in 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	155,648	$25,810,671	1922	162,815	$22,205,400
1920	143,244	24,564,572	1923	163,240	23,660,381
1921	102,463	14,801,032	1924	173,859	25,711,159

[a] Includes sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

The canvass of natural mineral pigments was discontinued after 1915. Iron ore sold for paint in 1919–1924 is shown below.

Iron ore sold for paint, by producers, in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	17,885	$84,630	1922	30,668	$166,682
1920	27,382	112,364	1923	27,823	140,306
1921	11,624	56,824	1924	23,106	103,626

MOLYBDENUM

PRODUCTION

Molybdenum in ore and concentrates, produced in the United States, sold in 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	297,926	$341,814	1922		
1920	34,900	17,207	1923	22,667	(a)
1921			1924	297,174	(a)

[a] Not reported.

IMPORTS

"Molybdenum ore[a] (steel-hardening)" imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	[b] 106,743	$77,572	1922	[b] 412,221	$90,015
1920	[b] 15,639	9,707	1923	[c] 16,671	13,115
1921	[b] 29,783	20,471	1924	[c] 10,379	9,038

[a] Prior to Sept. 22, 1922, imports recorded as ore; beginning with new tariff, recorded as molybdenum content of ore.
[b] Recorded as molybdenum ore.
[c] Recorded as molybdenum content of ore.

For imports of ferromolybdenum see under Ferroalloys. Exports of ferromolybdenum are not separately classified.

NICKEL

PRODUCTION

Nickel contained in nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1919–1924, and from mined ores in 1919 and 1920

Year	Short tons	Value	Year	Short tons	Value
1919 *	511	$656,485	1922	228	$130,116
1920 *	302	282,259	1923	330	77,019
1921	113	30,809	1924	282	134,962

* Including nickel contained from copper-lead-cobalt-nickel ore mined in Missouri.

IMPORTS AND EXPORTS

Nickel imported for consumption in the United States, 1909–1924

Year	Nickel, nickel ore, nickel matte, nickel oxide, and alloys of nickel not specified, ore		Manufactures from nickel, nickel alloys, and alloys	Total Value
	Pounds	Value		
1909	46,440,870	$14,407,740	$246,404	$14,527,407
1910	4,206,153	1,210,547	107,120	1,317,473
1911	14,413,102	3,441,126	133,173	4,033,544
1912	43,099,206	9,891,403	92,477	9,936,879
1913	46,515,981	9,121,894	86,307	9,199,201

Nickel imported for consumption in the United States, 1913–14, by classes

Class	1923		1924	
	Pounds	Value	Pounds	Value
Nickel ore and matte (nickel content)	54,600,420	$8,730,646	21,322,293	$3,965,084
Nickel alloys pig, bars, etc.	20,750,101	3,320,016	24,180,842	4,340,928
Nickel oxide	4,284,732	396,850	981,547	188,242
All other manufactures	137,293	82,477	142,761	86,207
	80,796,227	8,094,172	47,464,703	8,288,131

Nickel, nickel oxide, and matte exported from the United States, 1919–1924*

Year	Pounds	Value	Year	Pounds	Value
1919	3,815,240	$1,407,348	1922	4,927,287	$1,016,302
1920	4,774,200	974,502	1923 *	11,200	129
1921	620,503	108,173	1924 *		

* Nickel oxide and matte only after 1922. Separate figures for nickel not available. See following table.

Nickel exported from the United States, 1919–21, by classes

Class	1919		1920	
	Pounds	Value	Pounds	Value
Oxide and matte	[illegible]	[illegible]	[illegible]	[illegible]
Nickel	[illegible]	[illegible]	[illegible]	[illegible]
Nickel, metal and mixt alloys	[illegible]	[illegible]	[illegible]	[illegible]
Manufactures	[illegible]	[illegible]	[illegible]	[illegible]
Nickel or German silver in bars, rods or sheets	[illegible]	[illegible]	[illegible]	[illegible]

OILSTONES AND SCYTHESTONES

[See Abrasive materials]

ORE

Crude metallic ores (including tailings, etc.) shipped from or treated at the mines in the United States, 1910–1921, in short tons

[Partly estimated]

Class of ore	1910	1911	1912	1913	1914
Aluminium ore (bauxite)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chromite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gold and silver ore	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Iron ore †	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Manganese ore (35 per cent or more Mn) †	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Manganiferous ore (5 to 35 per cent Mn) †	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Quicksilver ore	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Copper ore:					
Western States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Central States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Eastern States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Copper-lead and copper-lead-zinc ore	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead ore:					
Western States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Central States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Eastern States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead-zinc ore:					
Western States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Central States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Eastern States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Zinc ore:					
Western States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Central States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Eastern States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Grand total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* Exclusive of fluxing ore.

PEAT

PRODUCTION

Peat produced in the United States, 1918–1921

Year	Short tons	Value	Year	Short tons	Value
1918	91,537	$[illegible]	1920	91,894	$[illegible]
1919	70,994	[illegible]	1921	61,333	[illegible]
1920	91,410	[illegible]	1922	32,409	[illegible]

IMPORTS

Peat moss imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	464	$16,345	1922	4,805	$33,034
1920	2,762	36,201	1923	5,973	43,184
1921	3,450	22,754	1924	5,541	47,208

No exports of peat are reported.

PETROLEUM

PRODUCTION

Petroleum produced in the United States, 1919–1924

[Barrels of 42 United States gallons]

Year	Barrels	Value at wells	Year	Barrels	Value at wells
1919	378,367,000	$760,266,000	1922	557,531,000	$895,111,000
1920	442,929,000	1,360,745,000	1923	732,407,000	978,430,000
1921	472,183,000	814,745,000	1924	713,940,000	1,022,683,000

Petroleum produced in the United States, 1922–1924, by fields and States

	1922		1923		1924	
	Barrels	Value at wells	Barrels	Value at wells	Barrels	Value at wells
FIELD						
Appalachian	29,180,000	$80,448,000	28,225,000	$78,886,000	27,056,000	$80,855,000
Lima-Indiana	2,269,000	5,063,000	2,404,000	4,820,000	2,287,000	4,550,000
Illinois and southwestern Indiana	10,231,000	21,018,000	9,500,000	17,690,000	8,747,000	15,420,000
Mid-Continent	310,992,000	532,738,000	348,460,000	535,060,000	375,479,000	549,570,000
Gulf coast	37,117,000	44,313,000	33,271,000	46,120,000	28,569,000	44,620,000
Rocky Mountain [a]	29,261,000	38,117,000	47,653,000	53,082,000	42,869,000	53,015,000
California	138,468,000	173,381,000	262,876,000	242,731,000	228,933,000	274,653,000
Other fields [b]	13,000	33,000	18,000	41,000		
	557,531,000	895,111,000	732,407,000	978,430,000	713,940,000	1,022,683,000
STATE						
Arkansas	12,712,000	20,416,000	36,610,000	25,400,000	46,028,000	43,130,000
California	138,468,000	173,381,000	262,876,000	242,731,000	228,933,000	274,653,000
Colorado	97,000	114,000	86,000	102,000	445,000	490,000
Illinois	9,383,000	19,291,000	8,707,000	16,250,000	8,081,000	14,220,000
Indiana	1,087,000	2,225,000	1,043,000	1,900,000	935,000	1,720,000
Kansas	31,766,000	56,131,000	28,250,000	45,970,000	28,836,000	44,400,000
Kentucky	8,973,200	17,758,000	8,069,000	15,900,000	7,407,000	14,592,000
Louisiana	35,376,000	53,169,000	24,919,000	36,530,000	21,124,000	30,340,000
Montana	2,449,000	4,048,000	2,782,000	4,080,000	2,815,000	3,754,000
New Mexico	[c]	[c]	[c]	[c]	98,000	127,000
New York	1,000,000	3,144,000	1,250,000	4,140,000	1,440,000	5,245,000
Ohio	6,781,000	17,369,000	7,085,000	17,050,000	6,811,000	17,165,000
Oklahoma	149,571,000	258,160,000	160,929,000	279,700,000	173,538,000	272,450,000
Pennsylvania	7,425,000	23,834,000	7,609,000	25,320,000	7,486,000	27,025,000
Tennessee	9,800	17,000	8,000	14,000	10,000	18,000
Texas	118,684,000	189,175,000	131,023,000	193,580,000	134,522,000	203,870,000
West Virginia	7,021,000	22,891,000	6,358,000	20,822,000	5,920,000	20,840,000
Wyoming	26,715,000	33,955,000	44,785,000	48,900,000	39,498,000	48,600,000
Undistributed [b]	13,000	33,000	18,000	41,000	13,000	44,000
	557,531,000	895,111,000	732,407,000	978,430,000	713,940,000	1,022,683,000

[a] Production of Alaska included with Rocky Mountain for 1924.
[b] Alaska, Missouri, and New Mexico.
[c] Included under "Undistributed."

STOCKS

Stocks of crude petroleum held in the United States on December 31, 1923–24, in barrels

		1923	1924
Domestic petroleum—pipe-line and tank-farm stocks:			
East of California—			
Appalachian—			
New York, Pennsylvania, West Virginia, eastern and central Ohio	gross	6,606,000	7,261,000
	net	6,331,000	7,020,000
Kentucky	gross	3,007,000	2,388,000
	net	2,879,000	2,266,000
Lima-Indiana	gross	1,211,000	1,431,000
	net	975,000	1,221,000
Illinois and southwestern Indiana	gross	11,528,000	11,401,000
	net	11,091,000	10,870,000
Mid-Continent—			
Oklahoma, Kansas, and north, central, and west Texas	gross	183,052,000	187,884,000
	net	171,781,000	176,754,000
North Louisiana and Arkansas	gross	32,927,000	36,047,000
	net	31,123,000	33,804,000
Gulf coast	gross	24,355,000	20,565,000
	net	23,974,000	20,200,000
Rocky Mountain	gross	19,718,000	28,711,000
	net	19,704,000	28,672,000
Total pipe-line and tank-farm stocks east of California	gross	282,404,000	295,688,000
	net	267,858,000	280,807,000
California [a]		62,162,000	68,867,000
Foreign petroleum held in the United States by importers elsewhere than at refineries:			
At Atlantic coast stations—			
Crude		324,000	199,000
Topped oil topped in Mexico		2,806,000	[b]
At Gulf coast stations—			
Crude		1,059,000	535,000
Topped oil topped in Mexico		565,000	[b]
		4,754,000	[b] 734,000
Total domestic net pipe-line and tank-farm stocks east of California, California stocks, and foreign stocks (as stated above)		334,774,000	350,408,000
Total crude oil at refineries		33,259,000	40,995,000
Producers' stocks at wells (not including California)		9,850,000	8,389,000
		377,883,000	[b] 399,792,000

[a] Producers', pipe-line, and tank-farm stocks of crude oil, residuum, and tops.
[b] Topped oil topped in Mexico excluded from stocks in 1924.

CONSUMPTION

Indicated deliveries of crude petroleum to domestic consumers, 1923–24, in barrels [a]

	1923	1924
Domestic petroleum (by field of origin):		
Appalachian	27,788,000	26,991,000
Lima-Indiana	2,126,000	2,044,000
Illinois and southwestern Indiana	8,563,000	8,967,000
Mid-Continent	297,051,000	368,686,000
Gulf coast	34,103,000	32,709,000
Rocky Mountain	29,640,000	34,122,000
California	250,089,000	222,228,000
Other	18,000	
Deliveries and exports	649,378,000	695,747,000
Exports	17,061,000	17,605,000
Deliveries in the United States and Territories	632,317,000	678,142,000
Foreign petroleum: Deliveries in the United States and Territories	81,999,000	78,056,000
	714,316,000	756,198,000

[a] Indicated deliveries equal production plus imports plus stocks, exclusive of refinery stocks, at beginning of period minus exports and stocks at end of period.

IMPORTS AND EXPORTS

Crude petroleum imported into and exported from the United States, 1920–1924

Year	Imports		Exports [a]	
	Barrels	Value	Barrels	Value
1920	106,175,289	$55,799,254	8,044,907	$28,990,444
1921	125,363,983	66,547,379	8,865,497	20,204,491
1922	127,308,423	70,383,309	9,995,093	18,348,110
1923	82,015,025	53,882,259	17,060,771	23,111,832
1924	77,775,173	73,841,507	17,604,877	26,495,011

[a] Exports of refined products and shipments of crude petroleum to Alaska, Hawaii, Porto Rico, and the Philippine Islands, and foreign petroleum reexported are not included. Exports of foreign crude petroleum have been as follows: 1920, 712,185 barrels, valued at $996,430; 1921, 74,136 barrels, $57,407; 1922, 167,724 barrels, $74,121; 1923, 324,607 barrels, $150,358; 1924, 367,662 barrels, $165,401.

PHOSPHATE ROCK

PRODUCTION

Phosphate rock, produced in the United States, sold in 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	2,271,983	$11,591,268	1922	2,417,883	$10,482,846
1920	4,103,982	25,079,572	1923	3,006,706	11,576,049
1921	2,064,025	12,270,070	1924	2,867,789	10,252,083

IMPORTS AND EXPORTS

Phosphate rock imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1920	63	$2,090	1,069,712	$10,570,175
1921	3,535	43,960	733,312	7,320,137
1922	5,890	95,846	719,294	5,858,167
1923	6,725	92,263	827,551	5,772,171
1924	16,098	181,515	818,773	5,120,832

PLATINUM AND ALLIED METALS

PRODUCTION

Reports received from refiners of crude platinum, gold bullion, and copper indicate that 66,007 troy ounces of refined new metals of the platinum group were recovered in 1924, of which about 7,280 ounces are believed to be of domestic origin.

New platinum and allied metals recovered by refiners in the United States, 1920–1924, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Other	Total
1920	36,015	4,309	418	409	393	41,544
1921	51,791	2,686	286	581	1,026	56,370
1922	54,142	1,943	210	1,301	122	57,718
1923	46,780	1,934	280	787	16	49,797
1924	57,827	6,065	680	1,261	174	66,007

Dealers and refiners reported recovery in 1924 of 54,471 ounces of secondary platinum metals derived from refining scrap and sweeps. The figures that make up this total probably represent some duplication, as the same metal may be handled as scrap several times in a year.

Secondary platinum and allied metals recovered in the United States, 1920–1924, in troy ounces

Year	Platinum	Palladium	Iridium	Other	Total
1920	51,255	3,100	3,355	----------	57,713
1921	39,131	4,887	1,776	229	46,02
1922	40,062	4,193	1,937	496	46,688
1923	39,152	6,246	2,021	453	47,872
1924	45,474	5,784	2,200	1,013	54,471

IMPORTS AND EXPORTS

Platinum and allied metals imported for consumption in the United States, 1919–1924

Year	Troy ounces	Value	Year	Troy ounces	Value
1919	68,054	$6,747,447	1922	110,025	$8,983,547
1920	100,546	10,617,440	1923	106,637	10,466,705
1921	78,378	5,418,464	1924	111,359	11,030,349

Platinum and allied metals imported for consumption in the United States, 1923–24, by metals

Metal	1923		1924	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Unmanufactured	86,417	$8,923,037	95,713	$9,824,113
Manufactures of, except jewelry	103	4,769	17	2,367
Iridium	1,611	276,539	1,397	214,384
Osmiridium	1,174	150,074	1,446	174,460
Osmium	1,462	147,154	350	38,931
Palladium	14,578	857,071	10,388	624,478
Rhodium	805	86,569	1,166	105,770
Ruthenium	487	21,492	882	45,846
	106,637	10,466,705	111,359	11,030,349

Platinum exported from the United States, 1920–1924

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1920	1,302	$177,115	(a)	$111,014
1921	3,272	244,473	741	85,216
1922 {Crude, scrap, and old	143	13,149	486	35,967
1922 {Ingots, sheets, wire, and alloys	1,313	127,047		
1923	1,151	128,599	592	65,073
1924	5,854	643,282	1,274	136,948

(a) Quantity not given.

POTASH

PRODUCTION

Potash produced and sold in the United States, 1920–1924

Year	Produced			Sold		
	Number of plants	Crude potash (short tons)	Available content of potash (K_2O) (short tons)	Crude potash (short tons)	Available content of potash (K_2O) (short tons)	Value f. o. b. plant
1923						
Mineral:						
Natural brines	3	32,254	17,982	31,079	17,984	$693,764
Dust from cement mills	7			4,036	1,285	90,028
Dust from blast furnaces						
Organic:						
Molasses distillery waste	1	6,700	2,211	44	11	654
Steffens waste water from beet-sugar refineries	1	75	22	5	1	225
Total, 1923	12	39,029	20,215	35,164	19,281	784,671
Total, 1922	12	25,176	11,714	22,028	11,313	463,512
Total, 1921	20	25,485	10,171	10,337	4,408	447,859
Total, 1920	66	166,834	48,077	139,963	41,444	7,463,026
1924						
Mineral:						
Natural brines	2	32,817	19,394	35,945	21,493	818,763
Dust from cement mills	1					
Dust from blast furnaces	6					
Organic:						
Molasses distillery waste	1	10,302	3,430	947	315	19,055
Steffens waste water from beet-sugar refineries	1	600	72	600	72	4,800
Total, 1924	11	43,719	22,896	37,492	21,880	842,618

Potash produced in the United States, 1923–24, by States, in short tons

State	Number of plants	Crude potash	Available content of potash (K_2O)
1923			
California	3	31,536	17,924
Indiana	1	75	22
Maryland	1	6,700	2,211
Nevada	1	718	58
Pennsylvania	6		
	12	39,029	20,215
1924			
California	3	32,121	19,361
Maryland	1	10,302	3,430
Indiana	1	1,296	105
Pennsylvania	6		
	11	43,719	22,896

STOCKS

Potash held by producers in the United States, December 31, 1923 and 1924, in short tons

Source	1923		1924	
	Crude potash	Available content of potash (K_2O)	Crude potash	Available content of potash (K_2O)
Mineral:				
Natural brines	10,309	4,890	4,596	1,507
Dust from blast furnaces	5,515	1,215		
Dust from cement mills				
Organic:				
Molasses distillery waste	18,900	6,237	27,749	9,238
Steffens waste water from beet-sugar refineries	70	21		
	34,794	12,363	32,345	10,745

IMPORTS AND EXPORTS

Potash materials imported for consumption in the United States, 1920–1924

Year	Potash salts used mainly in the fertilizer industry [a]			Potash salts used mainly in chemical industries [b]			Total		
	Short tons		Value	Short tons		Value	Short tons		Value
	Gross weight	Potash (K_2O) content		Gross weight	Potash (K_2O) content		Gross weight	Potash (K_2O) content	
1920	918,698	197,795	$33,885,627	63,564	26,997	$9,504,156	982,262	224,792	$43,389,783
1921	212,752	64,126	7,743,364	32,453	14,572	3,739,090	245,205	78,698	11,482,454
1922	632,711	186,264	10,951,197	34,198	15,151	4,415,891	666,909	201,415	15,367,088
1923	712,701	194,210	10,633,475	35,824	15,740	4,771,097	748,525	209,950	15,404,572
1924	663,914	187,079	10,042,575	28,336	13,286	3,325,552	692,250	200,365	13,368,127

[a] Includes kainite, manure salts, muriate, and sulphate. Considerable quantities of muriate and some sulphate were used in chemical industries.

[b] Includes bicarbonate, bichromate, bitartrate, bromide, carbonate, caustic, chlorate, chromate, cyanide, ferricyanide, ferrocyanide, iodide, nitrate, perchlorate, permanganate, and Rochelle salt.

Domestic potash salts exported from the United States, 1923–24

Material	1923			1924		
	Short tons		Value	Short tons		Value
	Gross weight	Potash (K_2O) content		Gross weight	Potash (K_2O) content	
Potassium bichromate	1,631	522	$295,751	585	187	$100,017
Potassium chlorate	100	38	21,995	281	107	31,577
All other potassium salts	2,266	997	188,091	1,057	465	169,442
	3,997	1,557	505,837	1,923	759	301,036

PUMICE

[See Abrasive materials]

PYRITES

PRODUCTION

Pyrites produced in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	420,647	$2,558,172	1922	169,043	$671,241
1920	310,777	1,596,961	1923	181,628	661,000
1921	157,118	711,432	1924	160,096	645,262

IMPORTS AND EXPORTS

Pyrites containing more than 25 per cent of sulphur imported for consumption in the United States, 1919–1924

Year	Long tons	Value	Year	Long tons	Value
1919	388,973	$2,176,565	1922	279,445	$1,199,076
1920	332,606	1,660,832	1923	263,695	1,254,389
1921	216,229	818,852	1924	246,737	598,544

Exports of "pyrites or other sulphur ore" in 1922 amounted to 323 long tons, valued at $4,325. Data for other years are not separately shown.

QUARTZ

[See under Silica]

QUICKSILVER

PRODUCTION

Quicksilver produced in the United States, 1919–1924

[Flasks of 75 pounds]

Year	Flasks	Value	Year	Flasks	Value
1919	21,415	$1,933,560	1922	6,375	$368,348
1920	13,392	1,066,807	1923	7,937	521,302
1921	6,339	300,595	1924	10,061	691,090

IMPORTS AND EXPORTS

Quicksilver imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Flasks	Value	Flasks	Value
1920	14,169	$971,510	1,553	$129,993
1921	10,601	457,993	393	18,869
1922	16,920	757,842	291	15,910
1923	18,073	816,043	318	25,195
1924	13,170	566,820	208	14,333

RADIUM

[See Uranium and vanadium ores]

SALT

PRODUCTION

Salt sold or used by producers in the United States, 1920–1924

Year	Short tons				Total value
	Manufactured (evaporated)	In brine	Rock salt	Total	
1920	2,409,924	2,819,916	1,610,189	6,840,029	$29,894,075
1921	1,931,243	1,577,335	1,472,576	4,981,154	24,557,966
1922	2,276,683	2,569,042	1,947,124	6,792,849	27,464,838
1923	2,239,872	2,787,239	2,103,602	7,130,713	27,795,941
1924	2,224,555	2,513,853	2,064,707	6,803,115	25,747,048

Salt sold or used by producers in the United States, 1923–24, by States

State	1923		1924	
	Short tons	Value	Short tons	Value
California	252,465	$1,327,917	268,112	$1,361,166
Idaho	31	310	33	350
Kansas	845,163	3,570,135	794,303	2,781,217
Louisiana	359,161	1,808,762	383,104	2,182,797
Michigan	2,127,412	8,684,148	1,918,463	7,864,838
New Mexico	525	5,250	1,700	17,000
New York	2,065,842	7,431,155	1,972,808	6,739,597
Ohio	1,102,387	3,695,248	1,102,214	3,641,585
Porto Rico	5,875	8,225	14,466	29,932
Utah	81,449	468,765	78,577	463,143
West Virginia	31,589	284,196	37,561	258,089
Undistributed [a]	258,814	511,830	231,774	407,334
	7,130,713	27,795,941	6,803,115	25,747,048

[a] 1923: Nevada, Texas, and Virginia; 1924: Texas and Virginia.

IMPORTS AND EXPORTS

Salt imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	137,654	$676,499	139,272	$1,901,593
1921	93,095	531,031	109,563	1,415,471
1922	113,922	522,338	134,989	1,429,172
1923	88,750	383,258	125,529	1,211,226
1924	88,938	324,092	144,945	1,288,376

SAND AND GRAVEL

PRODUCTION

Sand and gravel sold or used by producers in the United States, 1920–1924

Year	Glass sand		Molding sand		Building sand	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	2,165,926	$4,748,690	5,128,075	$7,504,759	26,539,365	$17,956,635
1921	1,280,359	2,314,314	1,906,977	2,451,966	24,565,605	16,053,413
1922	1,768,549	2,866,366	3,839,116	4,478,405	29,375,466	17,574,579
1923	2,034,958	3,751,778	5,559,644	6,730,417	39,234,762	23,751,244
1924	2,169,899	3,718,973	4,403,893	4,995,268	41,376,425	23,455,393

Year	Other sand		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	9,942,776	$8,988,530	38,265,246	$26,462,991	82,041,388	$65,661,605
1921	10,542,013	8,230,257	41,550,054	27,434,295	79,845,008	56,484,245
1922	14,711,792	10,550,570	45,172,123	29,147,744	94,867,046	64,617,664
1923	20,535,907	14,240,126	72,566,882	42,430,089	139,932,153	90,903,654
1924	27,621,793	16,674,831	80,658,053	48,168,650	156,230,063	97,013,115

IMPORTS AND EXPORTS

Sand and gravel imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	1,226,684	$912,282	(a)	$669,945
1921	906,905	771,734	(a)	379,982
1922	[b] 451,943	[b] 238,386	356,520	400,199
1923	[c] 477,762	[c] 259,820	551,233	598,633
1924	[c] 701,410	[c] 280,206	314,140	401,662

[a] Quantities not recorded prior to 1922.
[b] Includes 65,848 tons of gravel, valued at $27,434, and 1,290 tons of glass sand, valued at $1,112, imported after new tariff went into effect, Sept. 22. Not separately shown prior to that time.
[c] Includes: 1923, 198,960 tons of gravel, valued at $99,687, and 2,309 tons of glass sand, valued at $3,008; 1924, 448,586 tons, $155,146, and 6,479 tons, $1,961, respectively.

SAND-LIME BRICK

Sand-lime brick sold in the United States, 1919–1924 [a]

Year	Number of operators	Thousands	Value	Year	Number of operators	Thousands	Value
1919	35	146,947	$1,705,163	1922	(a)	(a)	(a)
1920	37	169,761	2,490,283	1923 [b]	33	213,425	$2,471,536
1921 [b]	26	97,126	1,268,502	1924 [b]	37	283,417	3,334,503

[a] Canvass discontinued by the U. S. Geological Survey after 1920. No canvass for 1922.
[b] According to Bureau of the Census. Figures represent production.

Imports of sand-lime brick were not reported separately until 1924. The figures for 1924 are 22,426,000 brick, valued at $129,042.

Exports are not reported separately.

SELENIUM

PRODUCTION

Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium, produced in the United States, sold in 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	60,025	$125,966	1922	123,565	$177,542
1920	92,141	175,508	1923	127,174	237,196
1921	55,978	89,148	1924	153,762	286,066

IMPORTS

Value of selenium and selenium salts imported for consumption in the United States, 1919–1924

1919	$25,866	1922	$2,530
1920	------	1923	1,653
1921	2,099	1924	606

SILICA

PRODUCTION

Quartz sold by producers in the United States, 1920–1924

Year	Crude		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	59,423	$142,397	8,767	$177,953	68,190	$320,350
1921	8,570	39,660	2,682	45,297	11,252	84,957
1922	5,085	23,093	5,568	78,254	10,653	101,347
1923	14,159	66,723	6,442	126,907	20,601	193,630
1924	20,570	123,099	3,191	80,078	23,761	203,177

Silica sold by producers in the United States for pottery, paints, fillers, polishers, abrasives, and other uses, 1923–24

Material	1923		1924	
	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	20,601	$193,630	23,761	$203,177
Sand and sandstone [a]	249,467	1,672,961	230,432	1,655,056
Tripoli (including rottenstone) (ground and otherwise prepared)	27,082	382,757	28,476	389,409
Diatomaceous earth	65,833	699,406	63,163	693,917
	362,983	2,948,754	345,832	2,941,559

[a] Includes only finely ground material. Figures probably incomplete.

IMPORTS

Imports of crude silica in 1924 were 12 short tons, valued at $254, compared with 34 tons, valued at $550, in 1923. Similar imports were not recorded prior to September 22, 1922, but from that date to the end of the year 1 ton, valued at $45, was imported. The Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground," from several countries. These imports are partly flint pebbles for use in grinding mills and partly material for uses such as are listed above. The figures can not be accurately separated.

"Flint, flints, and flint stones, unground" imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	19,798	$250,096	1922	16,040	$145,805
1920	26,636	338,630	1923	15,952	130,974
1921	10,084	116,157	1924	17,473	114,958

No exports of silica are reported.

SILVER

[See under Gold and silver]

SLATE

PRODUCTION

Slate sold by producers in the United States, 1920–1924, by uses

Year	Roofing slate		Mill stock		Slate for other uses[a]	Total value
	Number of squares (100 square feet)	Value	Square feet	Value		
1920	396,230	$3,524,658	9,910,000	$3,147,281	$2,054,503	$8,726,442
1921	348,085	3,197,745	8,970,000	2,719,723	1,404,538	7,322,006
1922	479,243	4,069,761	9,276,800	2,899,195	2,207,828	9,176,784
1923	507,587	4,582,535	11,109,480	4,159,644	3,334,445	12,076,624
1924	469,393	4,626,614	10,009,180	3,922,366	3,227,036	11,776,016

[a] Chiefly slate granules.

Value of slate sold by producers in United States, 1922–1924, by States

State	1922	1923	1924
Maine	$464,713	$754,826	$667,541
Maryland	[c]	[c]	117,137
New York	642,972	927,398	962,276
Pennsylvania	4,324,294	5,587,670	5,157,868
Vermont	2,907,858	3,857,287	4,010,346
Virginia	[b] 312,652	[b] 321,010	[b] 336,627
Undistributed [a]	[d] 524,295	[d] 628,433	[d] 524,221
	9,176,784	12,076,624	11,776,016

[a] Included under "Undistributed."
[b] Exclusive of value of granules, which is included under "Undistributed."
[c] 1922: Georgia, Maryland, New Jersey, and Tennessee; 1923: California, Georgia, Maryland, New Jersey, and Tennessee; 1924: California, Georgia, and Tennessee.
[d] Includes also value of granules for Virginia.

Slate sold by producers in the United States, 1923–24, by uses

Use	1923		1924	
	Quantity	Value	Quantity	Value
Roofing—squares	507,587	$4,582,535	469,393	$4,626,614
Approximate equivalent in short tons	171,300		158,420	
Electrical—square feet	2,182,890	1,754,717	1,801,450	1,518,092
Approximate equivalent in short tons	15,600		12,900	
Structural and sanitary—square feet	2,479,620	894,757	2,346,050	951,964
Approximate equivalent in short tons	17,730		16,640	
Grave vaults and covers—square feet	451,160	111,223	566,160	142,167
Approximate equivalent in short tons	6,450		8,100	
Blackboards and bulletin boards—square feet	4,415,710	1,186,864	4,069,670	1,151,767
Approximate equivalent in short tons	11,900		10,930	
Billiard table tops—square feet	527,680	180,981	341,200	131,028
Approximate equivalent in short tons	3,770		2,400	
School slates—pieces	2,144,900	31,102	1,710,240	27,348
Approximate equivalent in square feet	1,052,420		884,650	
Approximate equivalent in short tons	1,550		1,200	
Granules—short tons	462,260	3,268,554	512,810	3,178,454
Other—short tons (estimated)	16,540	65,891	4,300	48,582
Total (quantities approximate, in short tons)	707,100	12,076,624	727,700	11,776,016

IMPORTS AND EXPORTS

Value of slate imported for consumption in the United States, 1919–1924

1919	$691	1922	$2,753
1920	4,512	1923	16,881
1921	2,923	1924	32,095

Value of roofing slate exported from the United States, 1919–1924

1919	$55,164	1922	$97,811
1920	122,105	1923	78,780
1921	101,630	1924	77,422

The following figures for exports of slate other than roofing were collected by the Bureau of Mines from shippers of the products named:

Slate other than roofing exported from the United States, 1922–1924, by uses

Use	1922		1923		1924	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates—cases [a]	19,807	$194,962	21,502	$180,411	10,540	$113,865
Electrical slate—square feet	47,219	41,427	[b] 209,594	[b] 105,332	[b] 47,870	[b] 44,874
Blackboards—do	104,293	32,217	91,267	30,442	128,180	38,998
Billiard tables—do	69,160	29,897	50,429	22,922	4,340	1,757
Structural—do	2,319	1,407	([b])	([b])	([b])	([b])
		299,910		339,107		199,494

[a] Cases weigh from 130 to 165 pounds each; average is 135 pounds.
[b] Small quantity of structural slate included with electrical.

Producers also report exporting 5,109 short tons of roofing granules, valued at $38,126, in 1923, and 8,780 tons, $54,400, in 1924. Figures for earlier years are not available.

SOAPSTONE

[See Talc and soapstone]

SODIUM SALTS (NATURAL)

In addition to common salt, figures for which are given on page 69A, the following quantities of other natural sodium salts (including carbonate, bicarbonate, sulphate, trona, and borax) and colemanite have been shipped by the producers.

Sodium salts (other than NaCl), derived from natural sources in the United States, shipped by producers, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	29,120	$874,083	1922	45,406	$1,415,774
1920	42,683	1,513,179	1923	59,440	1,775,940
1921	25,000	894,000	1924	76,420	1,825,850

Borates (colemanite and naturally occurring borax) shipped by producers in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	66,146	$1,380,000	1922	85,220	$2,705,140
1920	120,320	2,173,000	1923	136,650	3,994,790
1921	50,000	1,600,000	1924	116,110	3,183,910

STEEL

[See Iron ore, pig iron, and steel]

STONE

PRODUCTION

Stone sold or used by producers in the United States, 1920–1924, by varieties

Year	Granite		Basalt and related rocks (trap rock)		Sandstone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	4,760,000	$24,954,908	9,219,200	$12,260,148	3,343,000	$7,310,290	431,500	$11,069,585
1921	4,752,180	20,592,217	8,524,480	11,450,899	2,640,460	6,425,339	315,400	8,580,416
1922	5,913,120	21,125,869	10,032,900	12,600,611	3,388,130	7,521,044	427,870	10,534,671
1923	7,300,130	29,704,796	10,674,470	13,539,648	4,349,270	9,174,706	562,560	12,863,974
1924	6,883,860	28,772,161	11,671,500	14,679,523	3,894,690	10,142,099	516,000	13,302,235

Year	Limestone		Other stone [a]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	59,290,000	$75,655,260	1,483,300	$2,291,769	78,527,000	$133,541,960
1921	45,621,000	57,749,594	1,685,220	2,163,801	63,538,740	106,962,266
1922	58,928,660	68,397,927	1,520,880	1,886,806	80,211,560	122,066,928
1923	76,701,360	89,620,007	3,730,870	4,567,110	103,318,660	159,470,241
1924	75,894,430	89,868,956	4,323,640	5,105,139	103,184,120	161,870,113

[a] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Stone sold or used by producers in the United States, 1923–24, by uses

Use	1923		1924	
	Quantity	Value	Quantity	Value
Building stone—cubic feet	26,417,020	$32,022,717	28,352,380	$33,175,656
Approximate equivalent in short tons	2,058,930		2,211,750	
Monumental stone—cubic feet	5,100,350	16,130,230	4,750,980	15,305,386
Approximate equivalent in short tons	423,610		393,550	
Paving blocks—number	45,866,480	4,003,490	41,037,570	3,578,676
Approximate equivalent in short tons	462,210		375,860	
Curbing—cubic feet	3,227,810	2,936,313	3,815,850	3,468,821
Approximate equivalent in short tons	252,300		296,070	
Flagging—cubic feet	607,600	422,059	810,440	560,156
Approximate equivalent in short tons	43,860		59,840	
Rubble—short tons	882,010	1,298,050	864,790	1,160,258
Riprap—do	3,185,900	2,989,068	3,265,130	3,634,439
Crushed stone—do	62,322,710	67,928,651	68,198,440	73,861,576
Furnace flux (limestone and marble)—do	25,602,450	20,377,138	19,690,490	15,839,868
Refractory stone (ganister, mica schist, and dolomite)—short tons	1,151,900	1,572,794	1,093,940	1,389,413
Manufacturing industries (limestone and marble)—short tons	4,668,470	4,224,230	4,733,770	4,410,559
Other uses (chiefly agricultural limestone)—do	2,264,310	5,565,501	2,000,490	5,485,305
Total (quantities approximate, in short tons)	103,318,660	159,470,241	103,184,120	161,870,113

IMPORTS AND EXPORTS

Value of stone imported for consumption in the United States, 1919–1924

1919	$787,961	1922	$1,895,912
1920	1,795,575	1923	2,641,337
1921	1,253,959	1924	2,437,654

Stone imported for consumption in the United States, 1923–24

Kind	1923		1924	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
In blocks, rough, etc.—cubic feet	699,412	$1,513,192	654,510	$1,278,696
Sawed—do	134	390	196	655
Slabs or paving tiles—superficial feet	133,244	54,618	309,999	97,935
All other manufactures		283,109		205,353
Mosaic cubes of marble or onyx:				
Loose		21,647		13,016
Attached to paper				142
		1,872,956		1,595,797
Granite:				
Dressed		270,432		302,927
Rough—cubic feet	176,096	221,796	196,176	255,225
		492,228		558,152
Stone (other):				
Dressed		17,305		22,044
Rough (monumental or building stone)—cubic feet	80,770	74,377	152,431	122,309
Rough (other)		184,471		139,352
		276,153		283,705
Grand total		2,641,337		2,437,654

Value of stone exported from the United States, 1920–1924

Year	Marble and stone, unmanufactured	All other, manufactured	Total
1920	$774,442	$2,158,764	$2,933,206
1921	576,905	1,697,570	2,274,475
1922	681,658	903,102	1,584,760
1923	625,442	783,195	1,408,637
1924	499,602	448,731	948,333

STRONTIUM

PRODUCTION

No domestic production of strontium ore has been reported since 1918.

Strontium chemicals, manufactured in the United States from domestic and imported crude ore, sold in 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	2,191,409	$402,057	1922	2,040,550	$204,022
1920	4,713,015	864,251	1923	2,676,260	303,719
1921	847,368	118,655	1924	3,061,532	303,456

IMPORTS

Imports of strontium ore have been as follows: 1924, 1,661 short tons, valued at $14,487; 1923, 1,679 tons, $12,564. No record of similar imports was kept prior to the new tariff (September 22, 1922), but from that date until the end of the year 1,000 pounds, valued at $40, was imported.

Strontium chemicals and ore imported for consumption in the United States, 1919–1924[a]

Year	Pounds	Value	Year	Pounds	Value
1919	1,225,952	$3,380	1922[a]	390,644	$22,986
1920	1,659,083	15,479	1923	5,281,818	131,420
1921	1,212,758	4,393	1924	3,993,226	59,937

[a] Celestite (strontium sulphate ore), strontium nitrate, and some other chemicals not included in record prior to Sept. 22, 1922.

No exports of strontium ore or strontium chemicals have been reported.

SULPHUR

PRODUCTION

Sulphur produced and shipped in the United States, 1919–1924

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1919	1,190,575	678,257	$10,252,000	1922	1,830,942	1,343,624	$22,000,000
1920	1,255,249	1,517,625	30,000,000	1923	2,036,097	1,618,841	26,000,000
1921	1,879,150	954,344	17,000,000	1924	1,220,561	1,537,345	25,000,000

IMPORTS AND EXPORTS

Sulphur imported into and exported from the United States, 1920–1924

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1920	136	$26,828	477,450	$8,994,350
1921	50	5,878	285,762	4,524,768
1922	296	14,743	487,969	7,209,357
1923	465	21,535	474,475	7,216,107
1924	1,005	40,293	484,143	7,894,201

TALC AND SOAPSTONE

PRODUCTION

Talc and soapstone sold by producers in the United States, 1920–1924, by classes

Year	Crude		Sawed and manufactured				Ground		Total	
			Talc		Soapstone					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	11,008	$43,820	1,415	$139,335	19,707	$709,400	178,505	$2,142,894	210,635	$3,035,449
1921	2,150	12,911	(a)	(a)	[a]17,423	[a]627,826	102,413	1,115,205	121,986	1,755,942
1922	4,981	22,582	654	86,333	22,700	712,144	170,349	2,038,838	198,684	2,859,897
1923	5,706	50,125	682	114,772	22,857	932,098	167,447	1,915,258	196,692	3,012,253
1924	5,710	22,247	846	109,405	25,630	1,288,885	171,635	2,095,019	203,821	3,515,556

[a] Talc included under "Soapstone."

IMPORTS AND EXPORTS

Talc imported for consumption in the United States, 1920–1924

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished [a]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	941	$7,206	21,739	$443,514	22,680	$450,720
1921	153	2,279	11,468	239,469	11,621	241,748
1922	248	9,850	18,196	367,528	18,444	377,378
1923	560	20,653	19,405	402,238	19,965	422,891
1924	313	4,847	17,496	337,508	17,809	342,355

[a] Prior to new tariff, Sept. 22, 1922, the classification was "Talc, steatite, and French chalk—cut, ground, or washed."

No material that might be classed as soapstone is imported.

Exports of "talcum and other toilet powders" have been as follows: 1924, 1,614 short tons, valued at $1,688,211; 1923, 1,907 tons, $1,671,588; 1922, 1,821 tons, $1,397,542. Exports were not separately classified prior to 1922.

TANTALUM

PRODUCTION

Columbite, mined in the United States, shipped in 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	300	$90	1922	600	$240
1920	4,000	1,450	1923	1,350	540
1921	3,400	1,150	1924	1,197	598

IMPORTS

No tantalum or "tantalum steel-hardening ores" were imported in 1924, 1922, or 1920. Imports of "tantalum steel-hardening ores" in 1923 were 5,600 pounds, valued at $3,031. In 1921, 6,785 pounds of "tantalum steel-hardening ores," valued at $1,327, and under the heading "Tantalum," 1,229 pounds of material, valued at $788, were imported. From the value given for the "tantalum," it seems probable that this mineral was tantalum ore.

No separate record of exports is kept.

TELLURIUM

Tellurium is a by-product of the electrolytic refining of copper. Figures of production are not available for publication. Imports and exports of tellurium are not reported.

THORIUM MINERALS

No monazite is known to have been produced in the United States from 1920 to 1924.

Monazite sand and thorium nitrate imported for consumption in the United States, 1920–1924

Year	Monazite sand		Thorium nitrate	
	Pounds	Value	Pounds	Value
1920	1,814,183	$141,528	35,640	$43,221
1921	50	40	44,554	89,672
1922	3,466,844	210,187	43,254	22,013
1923	253,730	11,334	24,027	29,789
1924	546,560	18,320	14,150	13,721

Exports of thorium nitrate in 1922 amounted to 1,103 pounds, valued at $3,149. Data for other years are not separately shown.

TIN

PRODUCTION

Tin mined in the United States (including Alaska), 1919–1924

[Metallic tin obtainable from concentrates produced in tin mining]

Year	Short tons	Value [a]	Year	Short tons	Value [a]
1919	56	$73,400	1922	[b] 1	$912
1920	22	22,000	1923	2	1,623
1921	4	2,400	1924	7	7,028

[a] Value calculated at average price per pound of Straits tin in New York, as published by American Metal Market.

[b] 2,800 pounds.

Smelter production of metallic tin in the United States, 1919–1924, in short tons

1919	12,236	1922	9,108
1920	17,652	1923	7,466
1921	11,542	1924	486

IMPORTS AND EXPORTS

Metallic tin imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	44,849	$50,890,019	1922	67,416	$40,797,986
1920	62,795	73,440,872	1923	77,206	61,092,354
1921	27,101	16,645,719	1924	72,866	68,953,193

Tin ore (concentrate) imported into the United States, 1919–1924

[General imports]

Year	Short tons	Value	Year	Short tons	Value
1919	19,196	$11,871,948	1922	13,804	$5,504,434
1920	34,148	18,795,162	1923	3,015	2,169,055
1921	15,340	5,672,861	1924	[a] 174	71,094

[a] Recorded as tin content.

Exports of tin ore are insignificant.

Metallic tin (pigs, bars, etc.) of domestic manufacture exported from the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	306	$415,921	1922	901	$574,792
1920	706	770,375	1923	840	646,250
1921	1,154	748,077	1924	469	453,482

TITANIUM MINERALS

PRODUCTION

Titanium minerals produced in the United States, 1920–1924 [a]

Year	Rutile concentrates		Ilmenite concentrates	
	Short tons	Percentage of TiO_2	Short tons	Percentage of TiO_2
1920	277	94–96	268	50
1921				
1922	310	95	5,181	52–54
1923	270	95	6,270	52
1924			4,769	52

[a] Bureau of Mines not at liberty to publish values.

IMPORTS

No titanium or "titanium steel-hardening" ores have been imported since 1918. Imports of "titanium potassium oxalate and all compounds and mixtures containing titanium" amounted to 24,134 pounds, valued at $3,639, in 1924; to 39,763 pounds, $6,423, in 1923; and to 82,544 pounds, $20,596, from September 22 to December 31, 1922. Similar imports were not separately classified prior to new tariff. For imports of ferrotitanium see under Ferroalloys.

No separate record of exports of titanium, "titanium steel-hardening" ores, or ferrotitanium is kept.

TRIPOLI

[See Abrasive materials]

TUNGSTEN

PRODUCTION

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide), produced in the United States, sold in 1919–1924, and average value per unit

Year	Short tons	Value	Average value per unit	Year	Short tons	Value	Average value per unit
1919	327	$353,900	$18.02	1922			
1920	216	101,800	7.86	1923	241	$144,600	$10.00
1921				1924	565	287,000	8.47

IMPORTS AND EXPORTS

Tungsten-bearing ores imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	9,408	$6,261,190	1922	1,651	$279,190
1920	1,949	779,593	1923		
1921	1,614	276,757	1924		

For imports of tungsten and ferrotungsten see under Ferroalloys.

For 1922 the following domestic exports are recorded: "Tungsten ores and concentrates (tungsten content)," 717 pounds, valued at $594. No tungsten ores of domestic production are recorded as exported in 1921, and, although exports for later years are not separately shown, it is practically certain that no domestic ores have been exported.

For exports of tungsten and ferrotungsten see under Ferroalloys.

URANIUM AND VANADIUM ORES

PRODUCTION

The market for radium was so overshadowed by the uranium deposits of Katanga, Belgian Congo, that only one company was able to isolate radium in the United States in 1924.

No vanadium is known to have been produced from domestic ores during 1924.

Uranium and vanadium ores shipped from mines in the United States, 1920–1924 •

Year	Ores		Radium isolated (grams)	Estimated content of ores		
	Short tons	Approximate value as ore		Radium (grams)	Uranium (short tons)	Vanadium (short tons)
1920	35,076	$2,401,000	32.539	43.4	143.5	526.7
1921	8,540	876,000	35.693	33.0	109.0	201.5
1922	929	166,016	24.189	7.0	23.2	25.9
1923	2,025	150,000	12.212	5.5	18.2	63.3

• Bureau of Mines not at liberty to publish figures for 1924. See preceding text.

IMPORTS

Value of uranium salts and oxide, including radium salts, imported for consumption in the United States, 1919–1924

1919	$12,960	1922	$28,685
1920	3	1923	500,456
1921	8,552	1924	418,307

No imports of "uranium-radium ore (steel-hardening)" were recorded for 1922 to 1924 and for 1919. Imports in 1920 and 1921 were 396 pounds, $1,110, and 250 pounds, $446, respectively.

Vanadium ore (steel-hardening) imported for consumption in the United States, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	3,013	$67,846	1922	306	$86,776
1920	10,337	1,080,935	1923	2,089	229,210
1921	5,154	543,061	1924	7,058	722,731

For imports of ferrovanadium see under Ferroalloys.

No separate record is kept of vanadium exports. For exports of ferrovanadium see under Ferroalloys.

ZINC

PRODUCTION

Primary zinc produced in the United States from domestic ores, 1919–1924

Year	Short tons	Value	Year	Short tons	Value
1919	452,272	$66,032,000	1922	353,274	$40,273,000
1920	450,045	72,907,000	1923	508,335	69,134,000
1921	198,232	19,823,000	1924	515,831	67,058,000

Primary zinc produced in the United States, 1920–1924, by sources of ore, in short tons

Source	1920	1921	1922	1923	1924
United States	450,045	198,232	353,274	508,335	515,831
Foreign:					
Australia	2,235	133			
Canada	1,583	521	55		1,396
Mexico	8,978	1,614	948	2,099	112
South America	536				
Total foreign	13,332	2,268	1,003	2,099	1,508
Grand total	463,377	200,500	354,277	510,434	517,339

Primary zinc produced in the United States, 1920–1924, by localities in which smelted, in short tons

Location of smelter	1920	1921	1922	1923	1924
Arkansas	31,481	15,278	13,627	29,870	28,447
Illinois	109,056	48,865	76,266	93,239	93,370
Kansas	41,044	16,573	24,167	32,006	28,640
Oklahoma	110,500	41,244	74,537	119,744	118,487
Pennsylvania	74,234	36,378	57,319	82,003	83,016
Other States	97,062	42,162	108,361	153,572	165,379
	463,377	200,500	354,277	510,434	517,339

Secondary zinc recovered as metal in the United States, 1920–1924, in short tons

	1920	1921	1922	1923	1924
Secondary zinc, redistilled	21,371	17,573	32,988	39,434	35,486
Secondary zinc, remelted	21,479	16,260	36,326	25,776	23,400
Secondary zinc recovered in alloys, excluding old brass remelted	7,650	5,840	10,250	8,630	10,500
Secondary zinc recovered in remelted brass (estimate)	65,000	38,600	60,000	65,000	63,000

IMPORTS AND EXPORTS

Zinc imported for consumption in the United States, 1920–1924

Year	Blocks or pigs		Sheets		Old		Zinc dust		Manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	value		
1920	(a)	$17	4	$614	14	$1,065	17	$6,207	$1,746	$9,649
1921	6,598	559,870	6,688	496,445	6	341	42	1,121	8,290	1,066,067
1922	40	3,327	416	59,037	46	2,403	79	5,614	9,517	79,898
1923	1	375	(b)	41	20	1,624	4	891	16,331	19,262
1924	11	1,973	(c)	88	14	1,493	59	9,241	20,089	32,884

(a) Less than 1 ton. (b) 584 pounds. (c) 712 pounds.

Zinc ore (zinc content) imported into the United States, 1922–1924, by countries [a]

[General imports]

Country	1922		1923		1924	
	Zinc content (short tons)	Value	Zinc content (short tons)	Value	Zinc content (short tons)	Value
Canada	235	$8,005	4	$521		
Mexico	1,665	10,971	3,201	343,649	4,649	$418,941
Other countries	29	2,988	18	2,702		
	1,929	21,964	3,223	346,872	4,649	418,941

[a] Ore imported duty free and containing less than 10 per cent of zinc excluded from figures as zinc content is not recovered.

Zinc exported from the United States, 1920–1924

Year	Domestic				Foreign	
	Slabs		Sheets		Slabs	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	74,046	$12,495,144	11,852	$2,832,993	28,132	$4,331,636
1921	1,753	204,984	1,816	425,618	1,256	100,677
1922	26,815	2,994,625	3,217	574,491	3,471	429,122
1923	42,131	5,961,525	3,732	764,369	7,080	941,257
1924	[a] 72,583	[a] 9,538,459	3,658	784,728	(a)	(a)

[a] Foreign included with domestic. Not separately recorded for 1924.

PRICES

[See statement on p. 15A]

ZINC RESIDUUM

[See Manganiferous zinc residuum]

ZIRCONIUM MINERALS

PRODUCTION

The Bureau of Mines has been advised that shipments of zircon from Pablo Beach, Fla., have been as follows: 1924, 281 short tons; 1923, 153 tons; and 1922, 10 tons. The bureau estimates the value as $39,340, $21,420, and $1,150, respectively. No shipments were reported for 1921 and 1920. Brazil is the world's main producer of zirconium ores. The zirconium minerals produced in Brazil and exported consist of the silicate, zircon, and the oxide, baddeleyite.

IMPORTS

Zirconium ores (steel-hardening) imported for consumption in the United States, 1919–1924

Year	Pounds	Value	Year	Pounds	Value
1919	11,023	$332	1922	67,037	$4,072
1920			1923		
1921	131,016	3,003	1924	616,220	4,878

STATE TABLES

Mineral production of Alabama in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	1,200	$4,200	8,498	$29,743
Barytes do	[a]	[a]	[a]	[a]
Bauxite long tons	[a]	[a]		
Cement barrels	[b] 3,395,392	[b] 6,257,673	[b] 5,542,687	[b] 9,147,367
Clay products		[c] 3,921,567		[c] 4,234,736
Clay, raw short tons	90,618	[d] 118,419	86,939	[d] 120,945
Coal do	20,457,649	51,624,000	19,130,184	44,756,000
Coke do	4,654,075	[d] 19,817,394	4,541,058	[d] 17,404,066
Ferroalloys long tons	[a d]	[a d]	[a d]	[a d]
Fuller's earth short tons	[a]	[a]	[a]	[a]
Gold troy ounces	6	114		
Graphite, crystalline pounds	1,570,900	79,754	584,725	13,935
Iron ore long tons	6,922,663	15,540,198	6,557,596	13,927,551
Iron, pig do	2,784,625	[d] 64,912,809	2,667,361	[d] 55,791,228
Lime short tons	193,429	1,627,539	204,059	1,812,282
Manganese ore long tons	[a]	[a]	1,242	24,954
Manganiferous ore do	694	8,067	611	6,722
Mica, sheet pounds			[a]	[a]
Mineral waters gallons sold	4,878	763	[c]	[c]
Sand and gravel short tons	1,829,559	760,236	2,443,753	917,914
Silver troy ounces	1	1		
Stone short tons	[f] 1,299,160	[f] 1,401,693	1,253,990	2,003,521
Miscellaneous [g]		3,023,622		2,493,135
Total value, eliminating duplications		82,496,430		77,315,758

[a] Value included under "Miscellaneous."
[b] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Value not included in total value for State.
[e] No canvass for 1924.
[f] Exclusive of marble, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "a," "b," and "f" above.

Mineral production of Alaska in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Coal short tons	119,826	$755,000	99,663	$560,000
Copper pounds	85,920,645	12,630,335	74,074,207	9,703,721
Gold troy ounces	289,540	5,985,314	304,072	6,285,724
Lead short tons	410	57,382	631	100,899
Natural gas M cubic feet	[a]	[a]	[a]	[a]
Petroleum barrels	[a]	[a]	[a]	[a]
Platinum and allied metals troy ounces	16	1,856	779	65,131
Silver do	814,649	668,012	669,641	448,659
Stone short tons	[a]	[a]	[a]	[a]
Tin (metallic equivalent) do	2	1,623	7	7,028
Miscellaneous [b]		141,615		190,672
Total value, eliminating duplications		20,241,137		17,361,834

[a] Value included under "Miscellaneous."
[b] Includes minerals indicated by "a" above.

Mineral production of Arizona in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Arsenious oxide	short tons			[a]	[a]
Asbestos	do	4	$1,133	132	$30,551
Clay products			[b] 102,337		[b] 98,564
Clay, raw	short tons	30	[c] 360		
Copper	pounds	618,928,602	90,982,504	677,752,013	88,785,514
Feldspar (crude)	long tons	[a]	[a]	[a]	[a]
Gems and precious stones			[d]		[e]
Gold	troy ounces	296,109	6,121,121	235,996	4,878,465
Gypsum	short tons	[a]	[a]	[a]	[a]
Lead	do	8,146	1,140,408	9,321	1,491,385
Lime	do	18,764	264,683	27,972	331,756
Manganese ore	long tons	245	[a]	42	798
Pumice	short tons	10	150		
Pyrite (radio crystals)	pounds			3,105	1,617
Sand and gravel	short tons	[a]	[a]	69,225	17,752
Silica (quartz)	do	[a]	[a]		
Silver	troy ounces	7,343,742	6,021,868	6,649,276	4,455,015
Sodium sulphate from natural sources	short tons			[a]	[a]
Stone	do	285,540	211,787	160,350	176,768
Sulphuric acid (60° Baumé) [f]	do	[a b c]	[a b c]	19,665	[a c]
Zinc	do	260	35,299		
Miscellaneous [g]			184,403		173,645
Total value, eliminating duplications			104,940,213		100,325,413

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] From copper smelting.
[g] Includes minerals indicated by "[a]" above.

Mineral production of Arkansas in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Antimony ore	short tons	40	$800	100	$6,787
Asphalt (oil)	do			[a b]	[a b]
Bauxite	long tons	493,880	2,980,580	327,630	1,981,000
Clay products			[c d] 1,202,857		[c d] 1,356,425
Clay, raw	short tons	167	[b] 1,754	166	[b] 1,570
Coal	do	1,296,892	5,192,000	1,451,503	5,898,000
Gems and precious stones			[e]		[f]
Iron ore sold for magnets	long tons	10	[a]	5	[a]
Lead	short tons	25	3,500	20	3,200
Lime	do	14,941	136,185	13,984	131,108
Manganese ore	long tons	3,768	73,507	3,400	60,350
Manganiferous ore	do	4,773	20,047	7,991	37,170
Marl, calcareous	short tons	[a]	[a]		
Mineral waters	gallons sold	723,341	60,119	[f]	[f]
Natural gas	M cubic feet	24,215,000	3,255,000	36,616,000	4,908,000
Natural-gas gasoline	gallons	16,183,000	1,916,000	17,533,000	1,784,000
Oilstones	short tons	[a]	[a]	214	143,264
Petroleum	barrels	36,610,000	25,400,000	46,028,000	43,130,000
Sand and gravel	short tons	1,572,240	826,304	2,944,022	1,560,379
Stone	do	517,050	673,197	[g] 542,190	[g] 620,626
Zinc	do	148	20,128	4	520
Miscellaneous [h]			194,095		229,855
Total value, eliminating duplications			41,954,319		61,748,999

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Exclusive of pottery, value for which is included under "Miscellaneous."
[e] No data available.
[f] No canvass for 1924.
[g] Exclusive of sandstone, value for which is included under "Miscellaneous."
[h] Includes minerals indicated by "[a]," "[d]," and "[g]" above.

Mineral production of California in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Antimony ore—short tons			13	$417
Arsenious oxide—do			(a)	(a)
Asbestos—do	65	$3,300	(a)	(a)
Asphalt:				
Native—do	2,945	11,780	3,731	14,088
Oil—do	451,462	[b] 5,040,556	492,045	[b] 5,869,315
Barytes—do	(a)	(a)		
Borates—do	(a)	(a)	(a)	(a)
Briquets, fuel—do	(a b)	(a b)	(a b)	(a b)
Calcium chloride—do	704	14,083		
Cement—barrels	10,882,802	26,022,156	11,481,730	25,532,707
Chromite—long tons	69	1,415	(a)	(a)
Clay products		[c] 20,833,053		[c] 20,994,732
Clay, raw—short tons	281,893	[b] 453,754	301,429	[b] 577,721
Coal—do	(a)	(a)	(a)	(a)
Copper—pounds	28,317,759	4,162,711	52,107,171	6,826,039
Diatomaceous earth—short tons	58,980	619,173	59,226	614,984
Feldspar (crude)—long tons	9,297	62,499	8,027	62,344
Gems and precious stones		[d]		[e]
Gold—troy ounces	647,210	13,379,013	636,140	13,150,175
Gypsum—short tons	111,832	670,495	(a)	(a)
Iron ore:				
Sold to furnaces—long tons	2,769	18,665	435	(a)
Sold for paint—do	10	(a)		
Lead—short tons	4,775	668,478	2,382	381,104
Lime—do	66,703	869,979	59,583	658,138
Lithium minerals—do			(a)	(a)
Magnesite—do	73,350	938,600	67,240	901,700
Magnesium chloride (natural)—pounds	5,728,879	74,064	(a)	(a)
Magnesium sulphate (natural)—do	(a)	(a)	(a)	(a)
Manganese ore—long tons	(a)	(a)	850	(a)
Marl, calcareous—short tons	18,303	109,437	(a)	(a)
Mineral waters—gallons sold	7,275,735	664,621	(e)	(e)
Natural gas—M cubic feet	131,434,000	22,787,000	189,692,000	35,949,000
Natural-gas gasoline—gallons	173,329,000	16,564,000	232,579,000	22,690,000
Peat—short tons	8,133	73,799	7,084	67,952
Pebbles for grinding—do	(a)	(a)	(a)	(a)
Petroleum—barrels	262,876,000	242,731,000	228,933,000	274,653,000
Platinum and allied metals—troy ounces	292	39,355	93	13,814
Potash (K_2O)—short tons	19,000	766,138	21,485	817,991
Pumice—do	431	6,289	(a)	(a)
Pyrites—long tons	(a)	(a)	(a)	(a)
Quicksilver—flasks	5,447	357,759	7,966	547,185
Salt—short tons	252,465	1,327,917	268,112	1,361,166
Sand and gravel—do	7,205,516	5,033,457	11,132,930	6,653,536
Sand-lime brick—thousands	(a c)	(a c)	(a c)	(a c)
Shale oil—gallons	160,000	(f)	210,000	(f)
Silica (quartz)—short tons	4,465	25,649	6,993	31,424
Silver—troy ounces	3,559,443	2,918,743	3,555,133	2,381,939
Slate		(a)		(a)
Sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources—short tons	39,600	809,050	56,037	968,790
Stone—do	7,614,670	8,428,584	7,192,730	8,635,602
Talc and soapstone—do	16,144	224,838	16,335	247,799
Tungsten ore (60 per cent concentrates)—do			(a)	(a)
Zinc—do			1,530	198,900
Miscellaneous [g]		4,395,598		3,961,966
Total value, eliminating duplications		375,492,868		428,175,652

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] No data ava lable.
[g] Includes minerals indicated by "a" above.

Mineral production of Colorado in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide short tons			(a)	(a)
Cement barrels	(a)	(a)	(a)	(a)
Clay products		[b] $4,413,602		[b] $3,954,639
Clay, raw short tons	190,250	[c] 272,276	236,143	[c] 322,632
Coal do	10,346,218	33,299,000	10,444,098	31,863,000
Coke do	647,823	(a c)	735,520	(a c)
Copper pounds	4,248,109	624,472	2,713,219	355,432
Feldspar (crude) long tons	(a)	(a)	(a)	(a)
Ferroalloys do	(a c)	(a c)	(a c)	(a c)
Fluorspar short tons	6,044	59,710	12,301	135,411
Gems and precious stones		(d)		(e)
Gold troy ounces	318,870	6,591,629	415,692	8,593,116
Gypsum short tons	(a)	(a)	(a)	(a)
Iron ore long tons	4,102	(a)	4,702	(a)
Iron, pig do	(a c)	(a c)	(a c)	(a c)
Lead short tons	22,849	3,198,873	23,779	3,804,565
Lime do	(a)	(a)	(a)	(a)
Manganese ore long tons	2,278	41,203	5,338	48,042
Manganiferous ore:				
For fluxing do	10,376	25,940	4,488	(a)
For other purposes do	18,348	68,204	30,949	118,140
Mica, scrap short tons	(a)	(a)	35	726
Mineral paints, zinc and lead pigments do	14,562	[c] 1,798,112	16,622	[c] 2,162,959
Mineral waters gallons sold	171,089	55,072	(e)	(e)
Molybdenum pounds			(a)	(a)
Natural gas M cubic feet	800	400	47,600	1,700
Petroleum barrels	86,000	102,000	445,000	490,000
Pyrite (radio crystals) pounds	(d)	(d)	3,417	3,417
Sand and gravel short tons	185,994	126,967	1,219,526	799,215
Silver troy ounces	5,334,488	4,374,280	3,254,370	2,180,428
Stone short tons	[f] 543,480	[f] 749,798	825,940	1,221,574
Tungsten ore (60 per cent concentrates) do	241	144,600	(a)	(a)
Uranium and vanadium ores do	(a)	(a)	(a)	(a)
Zinc do	27,076	3,682,336	28,364	3,687,255
Miscellaneous [g]		15,539,934		17,700,798
Total value, eliminating duplications		61,379,146		61,487,882

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Figures not available.
[e] No canvass for 1924.
[f] Exclusive of marble, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "a" and "f" above.

Mineral production of Connecticut in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a b] $3,665,174		[a b] $3,469,921
Clay, raw short tons	703	[c] 1,139	661	[c] 7,601
Diatomaceous earth do			(d)	(d)
Feldspar (crude) long tons	8,780	75,379	6,572	51,422
Lime short tons	59,158	813,254	58,851	796,541
Mica:				
Scrap do	(d)	(d)	(d)	(d)
Sheet pounds	(d)	(d)		
Mineral waters gallons sold	1,077,195	63,732	(e)	(e)
Sand and gravel short tons	691,039	303,443	1,191,421	1,175,757
Sand-lime brick thousands			(a d)	(a d)
Silica (quartz) short tons	3,264	15,987	1,308	8,829
Stone do	1,482,710	1,830,413	[f] 1,849,670	[f] 2,251,566
Miscellaneous [g]		409,884		375,296
Total value, eliminating duplications		7,177,266		8,129,332

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Value included under "Miscellaneous."
[e] No canvass for 1924.
[f] Exclusive of limestone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "b," "d," and "f" above.

Mineral production of Delaware in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] $249,804		[a] $235,555
Clay, raw, short tons	5,282	[b] 29,400	5,710	[b] 66,254
Sand and gravel, do	53,022	34,113	41,499	33,271
Stone, do	84,440	132,157	93,130	243,279
Total value, eliminating duplications		416,074		512,105

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value not included in total value for State.

Mineral production of the District of Columbia in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] [b] $242,980		[a] $175,252
Ferroalloys, long tons	[c] [d]	[c] [d]	[c] [d]	[c] [d]
Sand and gravel, short tons	[c]	[c]	[c]	[c]
Sand-lime brick, thousands	[a] [c]	[a] [c]	[a] [c]	[a] [c]
Stone, short tons	7,470	20,576	8,370	15,760
Miscellaneous [e]		773,567		654,596
Total value, eliminating duplications		929,768		813,608

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value included under "Miscellaneous."
[d] Value not included in total value for State.
[e] Includes minerals indicated by "[b]" and "[c]" above.

Mineral production of Florida in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] [b] $214,157		[a] [b] $239,073
Clay, raw, short tons	[c] [d]	[c] [d]	50,247	[c] 692,657
Fuller's earth, do	60,996	973,121	64,731	1,037,642
Ilmenite, do	5,804	[e] 116,080	4,769	[d]
Lime, do	[d]	[d]	[d]	[d]
Mineral waters, gallons sold	1,697,197	131,781	[f]	[f]
Peat, short tons	14	170	2,758	23,928
Phosphate rock, long tons	2,547,653	9,059,427	2,432,581	8,017,476
Sand and gravel, short tons	513,245	290,082	645,917	375,853
Sand-lime brick, thousands	[a] [d]	[a] [d]	[a] 18,706	[a] 200,535
Stone, short tons	1,494,080	1,425,434	2,973,360	2,942,778
Zircon, do	153	[e] 21,420	281	[e] 39,340
Miscellaneous [g]		989,687		224,598
Total value, eliminating duplications		12,557,822		13,101,223

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Value included under "Miscellaneous."
[e] Value estimated by the Bureau of Mines.
[f] No canvass for 1924.
[g] Includes minerals indicated by "[b]" and "[d]" above.

Mineral production of Georgia in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asbestos short tons	150	$1,350	(a)	(a)
Barytes do	83,291	670,343	71,776	$574,208
Bauxite long tons	22,553	141,975	16,140	101,780
Cement barrels	(a)	(a)	(a)	(a)
Clay products		[b] 5,739,128		[b] 6,032,950
Clay, raw short tons	319,021	[c] 1,077,196	347,218	[c] 1,214,570
Coal do	75,620	327,000	74,947	271,000
Coke do	12,556	[c] 126,690	8,081	[c] 71,355
Fuller's earth do	(a)	(a)	(a)	(a)
Gold troy ounces	26	529	32	655
Iron ore:				
Sold to furnaces long tons	117,286	300,712	112,059	285,128
Sold for paint do			482	(a)
Lime short tons	(a)	(a)	(a)	(a)
Manganese ore long tons	1,502	23,380	1,093	18,304
Manganiferous ore do	30,248	123,846	20,535	90,242
Mica:				
Scrap short tons	(a)	(a)	(a)	(a)
Sheet pounds	(a)	(a)	(a)	(a)
Mineral waters gallons sold	637,907	58,810	(d)	(d)
Sand and gravel short tons	595,117	300,621	874,527	242,754
Sand-lime brick thousands	(a b)	(a b)		
Silver troy ounces	2	1	5	3
Slate		(a)		(a)
Stone short tons	563,910	3,942,294	565,630	4,472,628
Talc do	796	16,568	1,885	30,548
Miscellaneous *		2,653,756		2,826,410
Total value, eliminating duplications		14,300,313		14,946,610

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] No canvass for 1924.
* Includes minerals indicated by "*" above.

Mineral production of Idaho in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] $135,920		[a] $205,172
Clay, raw short tons	133	[b] 1,297	570	[b] 5,550
Coal do	(c)	(c)	(c)	(c)
Copper pounds	3,979,631	585,006	2,738,824	358,786
Gems and precious stones		(d)		(d)
Gold troy ounces	37,124	767,427	26,922	556,523
Iron ore long tons	1,290	(c)		
Lead short tons	121,178	16,964,901	124,475	19,916,023
Lime do	(c)	(c)	(c)	(c)
Phosphate rock long tons	30,085	174,713	36,829	187,319
Pumice short tons	(c)	(c)		
Quicksilver flasks	(c)	(c)	(c)	(c)
Salt short tons	31	310	33	350
Sand and gravel do	97,044	43,039	113,028	33,734
Silver troy ounces	7,673,662	6,292,403	7,793,154	5,221,413
Stone short tons	175,050	205,486	211,030	318,588
Zinc do	13,976	1,900,787	7,670	997,132
Miscellaneous *		35,352		36,583
Total value, eliminating duplications		27,105,344		27,831,623

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."
[d] Figures by States not available for 1923.
* No canvass for 1924.
* Includes minerals indicated by "*" above.

Mineral production of Illinois in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Asphalt (oil)	short tons	152,009	[a] $2,809,015	186,000	[a] $2,054,265
Cement	barrels	[b] 7,129,208	[b] 12,550,100	[b] 6,955,455	[b] 12,026,310
Clay products			[c] 34,218,987		[c] 33,591,368
Clay, raw	short tons	165,895	[a] 313,919	178,071	[a] 343,977
Coal	do	79,310,075	198,388,000	68,323,281	155,260,000
Coke	do	3,187,168	[a] 30,373,638	2,355,474	[a] 20,187,519
Ferroalloys	long tons	[a d]	[a d]		
Fluorspar	short tons	65,045	1,443,490	62,067	1,288,310
Fuller's earth	do	[d]	[d]	[d]	[d]
Iron, pig	long tons	3,741,002	[a] 94,878,917	2,695,961	[a] 59,299,519
Lead	short tons	1,381	193,340	1,464	234,240
Lime	do	92,633	978,658	89,132	934,199
Mineral paints, zinc and lead pigments	do	13,657	[a] 2,048,506	12,447	[a] 1,851,951
Mineral waters	gallons sold	390,578	14,648	[e]	[e]
Natural gas	M cubic feet	4,049,000	690,000	4,072,000	759,000
Natural-gas gasoline	gallons	7,356,000	851,000	9,091,000	795,000
Peat	short tons	[d]	[d]	[d]	[d]
Petroleum	barrels	8,707,000	16,250,000	8,081,000	14,220,000
Sand and gravel	short tons	11,951,045	7,460,738	12,313,979	7,281,766
Sand and sandstone (finely ground)	do	78,042	480,302	88,562	590,167
Sand-lime brick	thousands	[c d]	[c d]		
Silver	troy ounces	8,170	6,699	8,891	5,957
Stone	short tons	9,111,830	8,358,556	8,640,960	7,959,934
Sulphuric acid (60° Baumé) [f]	do	[c] 237,795	[a c] 2,128,687	219,469	[a] 1,986,000
Tripoli	do	11,522	117,201	13,466	116,188
Zinc	do	1,266	172,176	2,512	326,560
Miscellaneous [g]			787,785		407,028
Total value, eliminating duplications			282,760,623		235,796,027

[a] Value not included in total value for State.
[b] Exclusive of natural cement, value for which is included under "Miscellaneous."
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Value included under "Miscellaneous."
[e] No canvass for 1924.
[f] From zinc smelting.
[g] Includes minerals indicated by "[b]" and "[d]" above.

Mineral production of Indiana in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Asphalt (oil)	short tons	[a b]	[a b]	168,280	[b] $1,555,563
Cement	barrels	[a]	[a]	[a]	[a]
Clay products			[c] $15,643,128		[c] 16,368,139
Clay, raw	short tons	80,227	[b] 151,243	102,242	[b] 122,162
Coal	do	26,229,099	65,046,000	21,480,213	46,453,000
Coke	do	5,042,614	[b] 46,765,264	4,272,435	[b] 30,394,497
Iron, pig	long tons	3,021,504	[b] 70,270,894	2,571,411	[b] 52,507,720
Lime	short tons	126,296	1,151,083	116,927	991,003
Mineral paints, zinc and lead pigments	do	[a b]	[a b]	[a b]	[a b]
Mineral waters	gallons sold	500,064	152,082	[d]	[d]
Natural gas	M cubic feet	880,000	460,000	998,000	494,000
Peat	short tons	[a]	[a]	[a]	[a]
Petroleum	barrels	1,043,000	1,900,000	935,000	1,720,000
Potash (K_2O)	short tons	1	225	72	4,800
Rubbing stones, scythestones, and whetstones	short tons	484	47,193	304	38,002
Sand and gravel	do	10,918,278	4,990,506	12,933,373	5,070,339
Sand-lime brick	thousands	[a c]	[a c]	[a c]	[a c]
Stone	short tons	3,650,110	17,692,112	[e] 3,824,440	[e] 17,269,407
Sulphuric acid [f]	do			[a b]	[a b]
Miscellaneous [g]			26,024,564		25,493,371
Total value, eliminating duplications			130,885,954		112,299,075

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures obtained through cooperation with Bureau of the Census.
[d] No canvass for 1924.
[e] Exclusive of sandstone, value for which is included under "Miscellaneous."
[f] From zinc smelting.
[g] Includes minerals indicated by "[a]" and "[e]" above.

Mineral production of Iowa in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Cement	barrels	5,570,675	$10,351,971	4,881,613	$8,811,587
Clay products			[a b] 6,920,336		[a b] 5,669,810
Clay, raw	short tons	4,666	[c] 4,730	27,188	[c] 27,547
Coal	do	5,710,735	20,517,000	5,468,450	18,097,000
Ferroalloys	long tons	[c d]	[c d]	[c d]	[c d]
Gypsum	short tons	685,041	5,368,532	727,385	5,657,339
Lime	do	[d]	[d]	[d]	[d]
Mineral waters	gallons sold	45,072	8,907	[e]	[e]
Natural gas	M cubic feet	[d]	[d]	[d]	[d]
Sand and gravel	short tons	3,597,160	2,181,881	2,427,626	1,473,066
Sand-lime brick	thousands	[a d]	[a d]		
Stone	short tons	[f] 603,550	[f] 698,207	607,530	712,540
Miscellaneous [g]			744,706		630,827
Total value, eliminating duplications			46,174,897		40,459,869

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Value included under "Miscellaneous."
[e] No canvass for 1924.
[f] Exclusive of sandstone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "[b]," "[d]," and "[f]" above.

Mineral production of Kansas in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Asphalt (oil)	short tons	[a b]	[a b]	[a b]	[a b]
Cement	barrels	[c] 5,878,839	[c] $10,868,590	[c] 5,809,646	[c] $9,900,547
Chats	short tons	[d]	[d]	346,800	55,000
Clay products			[e] 4,425,067		[e] 4,024,535
Coal	short tons	4,443,149	14,275,000	4,247,733	12,854,000
Gypsum	do	135,019	842,740	141,908	894,262
Lead	do	17,598	2,463,720	18,560	2,969,600
Mineral paints, zinc and lead pigments	do	[a b]	[a b]	[a b]	[a b]
Mineral waters	gallons sold	494,048	77,935	[f]	[f]
Natural gas	M cubic feet	30,913,000	11,249,000	25,580,000	10,087,000
Natural-gas gasoline	gallons	8,775,000	690,000	11,658,000	913,000
Petroleum	barrels	28,250,000	45,970,000	28,836,000	44,400,000
Pumice	short tons	51,907	170,459	39,489	148,177
Salt	do	845,163	3,570,135	794,303	2,781,217
Sand and gravel	do	1,950,411	1,039,064	1,882,968	1,223,016
Stone	do	919,640	1,180,397	[g] 766,120	[g] 960,626
Zinc	do	100,969	13,731,784	105,392	13,700,960
Miscellaneous [h]			1,213,134		1,685,997
Total value, eliminating duplications			110,630,255		105,005,476

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Exclusive of natural cement, value for which is included under "Miscellaneous."
[d] Figures not available.
[e] Figures obtained through cooperation with Bureau of the Census.
[f] No canvass for 1924.
[g] Exclusive of sandstone, value for which is included under "Miscellaneous."
[h] Includes minerals indicated by "[a]," "[c]," and "[g]" above.

Mineral production of Kentucky in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Asphalt (native)	short tons	184,300	$1,468,396	274,743	$2,386,557
Barytes	do	(a)	(a)		
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			[b]7,610,179		[b]7,519,239
Clay, raw	short tons	102,195	[c]428,021	115,644	[c]500,349
Coal	do	44,777,317	113,542,000	45,147,204	84,733,000
Coke	do	559,711	(a c)	(a c)	(a c)
Fluorspar	do	45,441	945,402	47,847	988,940
Iron, pig	long tons	154,680	(a c)	99,055	(a c)
Lead	short tons	53	7,420	175	28,000
Lime	do	(a)	(a)	8,091	58,228
Mineral waters	gallons sold	210,367	33,050	(d)	(d)
Natural gas	M cubic feet	11,953,000	3,156,000	12,875,000	3,432,000
Natural-gas gasoline	gallons	7,601,000	1,067,000	7,274,000	769,000
Petroleum	barrels	8,069,000	15,900,000	7,407,000	14,592,000
Phosphate rock	long tons	(a)	(a)	(a)	(a)
Sand and gravel	short tons	2,101,840	1,279,441	3,442,457	1,629,973
Scythestones and whetstones	do	(a)	(a)	(a)	(a)
Stone	do	1,884,380	2,250,025	2,173,700	2,786,249
Zinc	do	270	36,720	492	63,960
Miscellaneous [e]			10,004,567		5,833,023
Total value, eliminating duplications			148,853,786		120,510,775

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] No canvass for 1924.
[e] Includes minerals indicated by "a" above.

Mineral production of Louisiana in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Clay products			[a b]$731,252		[a b]$324,064
Mineral waters	gallons sold	(c)	(c)	(d)	(d)
Natural gas	M cubic feet	112,031,000	6,022,000	160,945,000	7,626,000
Natural-gas gasoline	gallons	40,720,000	3,484,000	48,098,000	3,887,000
Petroleum	barrels	24,919,000	36,530,000	21,124,000	30,340,000
Salt	short tons	359,161	1,808,762	383,104	2,182,797
Sand and gravel	do	2,905,609	1,926,917	3,132,447	2,287,495
Sand-lime brick	thousands	(a c)	(a c)	(a c)	(a c)
Stone	short tons	(c)	(c)	(c)	(c)
Sulphur	long tons	(c)	(c)	(c)	(c)
Miscellaneous [e]			10,696,117		10,283,325
Total value, eliminating duplications			61,199,048		56,930,681

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value included under "Miscellaneous."
[d] No canvass for 1924.
[e] Includes minerals indicated by "b" and "c" above.

Mineral production of Maine in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Clay products			[a] $877,555		[a] $707,044
Feldspar (crude)	long tons	25,029	230,122	29,912	271,354
Gems and precious stones			[b]		[c]
Lime	short tons	139,781	1,946,486	125,688	1,809,929
Millstones			2,350		
Mineral waters	gallons sold	973,442	415,353	[c]	[c]
Peat	short tons	14	560	[d]	[d]
Sand and gravel	do	531,937	169,905	303,398	149,454
Slate			754,826		667,541
Stone	short tons	306,620	3,168,396	[e] 263,720	[e] 2,411,938
Miscellaneous [f]					17,900
Total value, eliminating duplications			7,565,553		6,035,160

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Figures by States not available for 1923.
[c] No canvass for 1924.
[d] Value included under "Miscellaneous."
[e] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[f] Includes minerals indicated by "[d]" and "[e]" above.

Mineral production of Maryland in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Asbestos	short tons	8	$3,843	[a]	[a]
Cement	barrels	[a]	[a]	[a]	[a]
Chromite	long tons	80	1,840		
Clay products			[b] 4,909,498		[b] $3,973,074
Clay, raw	short tons	87,277	[c] 172,169	86,342	[c] 165,931
Coal	do	2,285,926	6,911,000	2,133,703	4,629,000
Coke	do	861,668	[a c]	810,118	[a c]
Diatomaceous earth	do	50	825	[a]	[a]
Feldspar (crude)	long tons	2,750	17,010	4,854	25,020
Ferroalloys	do	[a c]	[a c]	[a c]	[a c]
Iron, pig	do	489,137	[a c]	539,188	[a c]
Lime	short tons	63,858	553,811	56,178	470,105
Marl, calcareous	do	610	2,501	[a]	[a]
Mineral waters	gallons sold	874,689	88,568	[d]	[d]
Potash (K_2O)	short tons			315	19,055
Sand and gravel	do	2,044,490	2,155,353	2,418,137	2,368,813
Silica (quartz)	do	2,119	42,125	2,353	34,605
Slate			[a]		117,137
Stone	short tons	1,244,010	2,054,125	[e] 1,100,410	[e] 1,913,395
Talc	do	580	25,500	3,015	29,767
Miscellaneous [f]			25,719,638		22,919,163
Total value, eliminating duplications			21,189,542		18,506,867

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] No canvass for 1924.
[e] Exclusive of marble, value for which is included under "Miscellaneous."
[f] Includes minerals indicated by "[a]" and "[e]" above.

Mineral production of Massachusetts in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] $4,194,855		[a] $3,859,253
Clay, raw short tons	1,358	[b] 6,856	2,234	[b] 33,796
Coke do	554,125	[b c]	397,640	[b c]
Fuller's earth do	[e]	[e]	[e]	[e]
Iron, pig long tons	1,667	[b c]	50	[b c]
Lead short tons			[d]	[d]
Lime do	180,720	2,550,575	194,402	2,693,028
Mineral waters gallons sold	1,958,556	110,305	[e]	[e]
Peat short tons	[e]	[e]		
Sand and gravel do	1,813,715	1,821,116	2,904,911	2,496,148
Sand and sandstone (finely ground) do	[e]	[e]		
Sand-lime brick thousands	[a e]	[a e]	[a e]	[a e]
Silica (quartz) short tons			[e]	[e]
Stone do	1,788,860	5,794,941	[f] 1,936,520	[f] 6,063,048
Miscellaneous [g]		6,978,137		4,309,481
Total value, eliminating duplications		14,781,129		15,725,882

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."
[d] It is stated that a few tons of lead ore was mined and was treated at a small smelter owned by the mine operators. No figures are available.
[e] No canvass for 1924.
[f] Exclusive of sandstone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "e" and "f" above.

Mineral production of Michigan in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Bromine pounds	[a]	[a]	1,866,753	$552,055
Calcium chloride short tons	32,669	$578,462	50,269	1,097,377
Cement barrels	7,466,283	14,038,322	8,991,270	16,405,761
Clay products		[b] 6,959,278		[b] 10,246,953
Clay, raw short tons	3,617	[c] 7,327	9,332	[c] 14,041
Coal do	1,172,075	5,545,000	831,020	3,602,000
Coke do	1,648,773	[c] 14,389,742	1,770,547	[c] 11,914,028
Copper pounds	138,304,080	20,330,700	135,662,605	17,771,801
Gems and precious stones		[d]		[e]
Graphite, amorphous short tons	856	[a]	[a]	[a]
Grindstones do	[a]	[a]	[a]	[a]
Gypsum do	586,987	3,252,993	577,526	5,950,822
Iron ore:				
Sold to furnaces long tons	14,065,561	54,110,070	11,248,641	35,605,902
Sold for paint do	4,377	[a]	2,296	[a]
Iron, pig do	717,279	[c] 18,827,808	650,333	[c] 15,225,990
Lime short tons	59,629	612,369	73,096	702,072
Magnesium pounds	[a f]	[a f]	[a c]	[a c]
Magnesium chloride (natural) do	[a f]	[a f]	[a]	[a]
Magnesium sulphate (natural) do	[a]	[a]	[a]	[a]
Manganiferous ore long tons	224,779	[a]	90,495	[a]
Marl, calcareous short tons	2,000	3,000	2,500	3,120
Mineral waters gallons sold	1,478,135	164,968	[e]	[e]
Natural gas M cubic feet	700	320	600	300
Peat short tons	[a]	[a]	[a]	[a]
Salt do	2,127,412	8,684,148	1,918,463	7,864,838
Sand and gravel do	9,601,562	5,096,071	11,381,084	5,975,757
Sand-lime brick thousands	[b] 65,162	[b] 783,271	[b] 89,239	[b] 1,052,435
Silver troy ounces	223,997	183,678	130,381	87,355
Stone short tons	[g] 10,715,910	[g] 6,303,136	10,023,440	5,943,680
Miscellaneous [h]		1,645,664		1,444,738
Total value, eliminating duplications		128,291,450		114,239,386

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] Partly estimated.
[g] Exclusive of serpentine, value for which is included under "Miscellaneous."
[h] Includes minerals indicated by "d" and "g" above.

Mineral production of Minnesota in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			[b] [c] $2,031,408		[b] [c] $1,675,204
Clay, raw	short tons	[a] [d]	[a] [d]	21,545	[d] 34,705
Coke	do	695,824	[d] 5,104,330	514,764	[d] 4,903,891
Flint lining for tube mills	do	(a)	(a)	(a)	(a)
Gems and precious stones			(e)		(f)
Iron ore	long tons	44,556,053	158,402,788	31,076,114	93,311,092
Iron, pig	do	418,726	[a] [d]	189,033	[a] [d]
Lime	short tons	29,805	339,957	25,764	319,066
Manganiferous ore	long tons	752,815	2,286,960	521,442	1,409,483
Marl, calcareous	short tons	150	263	(a)	(a)
Millstones			(a)		
Mineral waters	gallons sold	1,806,292	136,855	(f)	(f)
Pebbles for grinding	short tons	(a)	(a)	(a)	(a)
Sand and gravel	do	3,826,472	2,184,106	3,000,007	1,883,029
Sand-lime brick	thousands	[a] [b]	[a] [b]	[b] 16,337	[b] 103,052
Stone	short tons	701,210	4,281,687	804,280	4,220,658
Miscellaneous [g]			15,036,262		9,099,237
Total value, eliminating duplications			174,105,328		107,844,680

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Exclusive of pottery, value for which is included under "Miscellaneous."
[d] Value not included in total value for State.
[e] Figures by States not available for 1923.
[f] No canvass for 1924.
[g] Includes minerals indicated by "a" and "c" above.

Mineral production of Mississippi in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Clay products			[a] [b] $878,684		[a] $955,328
Clay, raw	short tons	2,059	[c] 11,380	2,195	[c] 7,619
Mineral waters	gallons sold	93,441	23,379	(d)	(d)
Sand and gravel	short tons	2,772,149	1,229,809	2,442,911	1,134,288
Stone	do	(e)	(e)	(e)	(e)
Miscellaneous			31,471		806
Total value, eliminating duplications			2,163,343		2,090,422

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value not included in total value for State.
[d] No canvass for 1924.
[e] Value included under "Miscellaneous."

Mineral production of Missouri in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asphalt (native)—short tons			300	$3,150
Barytes—do	81,701	$629,097	77,189	604,390
Briquets, fuel—do	(a b)	(a b)	(a b)	(a b)
Cement—barrels	7,143,883	13,237,141	7,711,206	13,515,267
Chats—short tons	1,218,180	c 185,000	2,081,075	312,200
Clay products		d 17,903,774		d 16,338,161
Clay, raw—short tons	495,797	b 1,624,789	459,570	b 1,441,457
Coal—do	3,403,151	11,575,000	2,480,880	8,154,000
Coke—do	(a b)	(a b)	(a b)	(a b)
Copper—pounds	202,556	29,776	182,811	23,948
Iron ore—long tons	54,348	247,975	79,847	405,622
Iron, pig—do	4,513	(a b)	21,371	(a b)
Lead—short tons	169,743	23,764,020	189,929	30,388,640
Lime—do	246,326	2,505,785	243,465	2,354,175
Mineral paints, zinc and lead pigments—do	(a b)	(a b)	(a b)	(a b)
Mineral waters—gallons sold	174,636	38,145	(e)	(e)
Natural gas—M cubic feet	17,000	14,000	71,000	61,000
Petroleum—barrels	(a)	(a)		
Sand and gravel—short tons	3,719,243	2,007,529	4,081,200	2,053,436
Silver—troy ounces	177,270	145,361	103,694	69,475
Stone—short tons	2,134,910	4,345,526	f 2,320,010	f 4,961,333
Tripoli—do	(a)	(a)	(a)	(a)
Zinc—do	18,265	2,484,040	12,920	1,679,600
Miscellaneous g		4,511,639		4,880,982
Total value, eliminating duplications		79,201,473		81,054,122

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Value estimated.
d Figures obtained through cooperation with Bureau of the Census.
e No canvass for 1924.
f Exclusive of basalt, value for which is included under "Miscellaneous."
g Includes minerals indicated by "a" and "f" above.

Mineral production of Montana in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide—short tons	3,492	$279,376	7,535	$602,818
Asbestos—do			1	190
Cement—barrels	(a)	(a)	(a)	(a)
Clay products		b 312,219		b 181,057
Clay, raw—short tons	11,624	c 20,033	10,272	c 15,103
Coal—do	3,147,678	9,652,000	2,905,365	8,596,000
Copper—pounds	224,125,264	32,946,414	249,152,062	32,638,920
Ferroalloys—long tons	(a c)	(a c)	(a c)	(a c)
Gems and precious stones		(d)		(e)
Gold—troy ounces	85,079	1,758,748	97,854	2,022,825
Gypsum—short tons	(a)	(a)	(a)	(a)
Iron ore—long tons	17,751	51,039	3,913	10,846
Lead—short tons	17,973	2,516,194	19,738	3,158,081
Lime—do	(a)	(a)	2,374	25,316
Manganese ore:				
For fluxing—long tons	769	(a)	1,833	(a)
For other purposes—do	21,916	674,509	35,445	939,919
Manganiferous ore (for fluxing)—do	2,827	(a)	3,774	(a)
Mineral waters—gallons sold	(a)	(a)	(e)	(e)
Natural gas—M cubic feet	1,470,000	317,000	1,071,000	272,350
Petroleum—barrels	2,782,000	4,080,000	2,815,000	3,754,000
Phosphate rock—long tons			491	1,650
Sand and gravel—short tons	365,303	156,057	597,161	172,151
Silver—troy ounces	13,380,862	10,972,307	13,289,303	8,903,833
Stone—short tons	f 275,900	f 270,781	251,730	235,580
Sulphuric acid (60° Baumé) f—do			46,397	(a c)
Zinc—do	70,730	9,619,307	64,238	8,350,889
Miscellaneous h		1,109,480		1,230,603
Total value, eliminating duplications		74,707,269		70,631,806

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Figures by States not available for 1923.
e No canvass for 1924.
f Exclusive of basalt, value for which is included under "Miscellaneous."
g From copper smelting.
h Includes minerals indicated by "a" and "f" above.

Mineral production of Nebraska in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Cement—barrels	(a)	(a)	(a)	(a)
Clay products		b c $939,138		b c $796,725
Clay, raw—short tons	255	d 965	13,092	d 14,172
Coal—do			(a)	(a)
Mineral paints, zinc and lead pigments—short tons	(a d)	(a d)		
Mineral waters—gallons sold	(a)	(a)	(e)	(e)
Potash (K_2O)—short tons	250	16,250		
Pumice—do	(a)	(a)	3,577	34,028
Sand and gravel—do	1,930,104	921,433	2,098,400	1,099,499
Stone—do	243,920	328,918	222,030	285,977
Miscellaneous f		1,099,348		993,196
Total value, eliminating duplications		3,302,397		3,209,425

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Exclusive of pottery, value for which is included under "Miscellaneous."
d Value not included in total value for State.
e No canvass for 1924.
f Includes minerals indicated by "e" and "c" above.

Mineral production of Nevada in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide—short tons	9,484	$758,747	3,196	$255,664
Barytes—do			(a)	(a)
Borates—do	(a)	(a)	(a)	(a)
Clay products		(a b)		(a b)
Clay, raw—short tons	1,060	c 10,900	3,360	c 35,806
Copper—pounds	67,204,282	9,879,029	73,805,323	9,668,497
Diatomaceous earth—short tons	400	5,500	332	5,570
Gems and precious stones		(d)		(e)
Gold—troy ounces	204,293	4,223,109	217,963	4,505,686
Graphite, amorphous—short tons	200	(a)	(a)	(a)
Gypsum—do	298,390	1,952,007	365,714	2,063,089
Iron ore—long tons	9,578	(a)		
Lead—short tons	9,078	1,270,944	10,030	1,604,803
Lime—do	(a)	(a)	(a)	(a)
Manganese ore—long tons			1,310	13,579
Manganiferous ore:				
For fluxing—do	28,571	(a)	16,710	(a)
For other purposes—do			2,591	15,997
Mineral waters—gallons sold	(a)	(a)	(e)	(e)
Quicksilver—flasks	(a)	(a)	(a)	(a)
Salt—short tons	(a)	(a)		
Sand and gravel—do	269,324	56,938	742,808	152,645
Shale oil—gallons	132,000	(f)	390,000	(f)
Silica (quartz)—short tons	433	2,415	2,500	12,000
Silver—troy ounces	10,614,564	8,703,942	9,411,379	6,305,624
Sodium sulphate from natural sources—short tons			(a)	(a)
Stone—do	84,240	89,585	202,270	167,324
Sulphur—long tons	(a)	(a)	(a)	(a)
Tungsten ore (06 per cent concentrates)—short tons			(a)	(a)
Zinc—do	7,083	963,325	5,501	715,189
Miscellaneous g		693,086		740,276
Total value, eliminating duplications		28,598,627		26,225,943

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d Figures by States not available for 1923.
e No canvas for 1924.
f No data available.
g Includes minerals indicated by "e" above.

Mineral production of New Hampshire in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a b] $913,389		[a] $868,444
Diatomaceous earth short tons	50	2,500	[c]	[c]
Feldspar (crude) long tons	23,220	171,789	39,425	324,638
Fluorspar short tons	142	3,160		
Garnet, abrasive do	[c]	[c]	[c]	[c]
Mica:				
Scrap do	1,078	25,871	492	9,498
Sheet pounds	835,751	107,674	744,133	88,737
Millstones				1,595
Mineral waters gallons sold	156,607	12,642	[d]	[d]
Peat short tons			21	2,800
Sand and gravel do	505,063	423,854	495,602	416,014
Scythestones do	[c]	[c]	[c]	[c]
Silica (quartz) do	[c]	[c]	[c]	[c]
Stone do	122,460	1,763,221	[e] 93,340	[e] 1,556,598
Miscellaneous [f]		148,515		109,841
Total value, eliminating duplications		3,572,615		3,378,165

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Exclusive of pottery, value for which is included under "Miscellaneous."
[c] Value included under "Miscellaneous."
[d] No canvass for 1924.
[e] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[f] Includes minerals indicated by "[b]", "[c]", and "[e]" above.

Mineral production of New Jersey in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Briquets, fuel short tons	[a b]	[a b]	[a b]	[a b]
Cement barrels	[a]	[a]	[a]	[a]
Clay products		[c] $44,921,714		[c] $46,414,167
Clay, raw short tons	376,854	[b] 1,650,900	352,734	[b] 1,486,032
Coke do	897,569	[a b]	869,120	[a b]
Ferroalloys long tons	[a b]	[a b]	[a b]	[a b]
Iron ore:				
Sold to furnaces do	349,435	1,403,723	101,123	420,488
Sold for paint do			208	[a]
Iron, pig do	206,196	[a b]	[a b]	[a b]
Lime short tons	[a]	[a]	204	1,516
Manganiferous residuum [d] long tons	132,801	[a]	119,457	[a]
Marl, greensand short tons	10,656	131,123	14,055	151,205
Mineral paints, zinc and lead pigments do	[a b]	[a b]		
Mineral waters gallons sold	507,680	50,261	[e]	[e]
Peat short tons	18,380	107,885	23,523	172,863
Sand and gravel do	6,101,204	4,381,855	3,968,361	3,345,764
Sand and sandstone (finely ground) do	[a]	[a]	[a]	[a]
Sand-lime brick thousands			[a c]	[a c]
Slate		[a]		
Stone short tons	2,039,740	3,032,918	2,149,270	3,326,298
Talc do	[a]	[a]	[a]	[a]
Zinc do	75,227	[a]	84,370	[a]
Miscellaneous [f]		32,722,018		31,270,680
Total value, eliminating duplications		72,602,066		75,271,009

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Ore mined in New Jersey; smelted in Pennsylvania.
[e] No canvass for 1924.
[f] Includes minerals indicated by "[a]" above.

Mineral production of New Mexico in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide short tons			[a]	[a]
Clay products		[b] $133,118		[b] $18,611
Clay, raw short tons	3,135	[c] 11,939	3,596	[c] 13,603
Coal do	2,915,173	10,668,000	2,786,063	9,774,000
Coke do	[a c]	[a c]	83,070	[a c]
Copper pounds	61,356,802	9,019,450	74,691,436	9,784,578
Fluorspar short tons	4,328	50,861	2,580	35,178
Gems and precious stones		[d]		[e]
Gold troy ounces	26,689	551,713	24,804	512,735
Gypsum short tons	[a]	[a]	[a]	[a]
Iron ore long tons	205,218	[a]	189,371	[a]
Lead short tons	1,916	268,270	1,817	290,761
Lime do	1,859	19,362	2,389	23,975
Lithium minerals do	[a]	[a]	[a]	[a]
Manganese ore long tons	179	3,693	775	[a]
Manganiferous ore do	6,759	17,398	23,246	[a]
Mica:				
Scrap short tons	898	16,417	178	3,248
Sheet pounds	30,300	8,489	29,803	6,583
Mineral waters gallons sold	2,125	643	[e]	[e]
Molybdenum pounds	22,667	[a]	[a]	[a]
Natural gas M cubic feet	[a]	[a]		
Petroleum barrels	[a]	[a]	98,000	127,000
Salt short tons	525	5,250	1,700	17,000
Sand and gravel do	464,410	239,470	526,787	267,110
Silver troy ounces	747,127	612,644	795,070	532,697
Stone short tons	[f] 396,980	[f] 241,786	654,610	432,023
Zinc do	8,248	1,121,728	10,380	1,349,348
Miscellaneous [g]		1,946,315		1,438,961
Total value, eliminating duplications		23,791,047		23,913,528

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] Exclusive of limestone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "a" and "f" above.

Mineral production of New York in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Aluminum pounds	[a b]	[a b]	[a b]	[a b]
Cement barrels	[c] 6,853,062	[c] $12,834,471	[c] 7,435,875	[c] $13,460,594
Clay products		[d] 25,226,187		[d] 26,140,688
Clay, raw short tons	8,247	[b] 43,701	5,948	[b] 31,238
Coke do	1,783,948	[b] 12,808,335	1,600,669	[b] 11,108,944
Diatomaceous earth do	208	13,378	199	12,995
Emery do	461	3,427	1,610	11,426
Feldspar (crude) long tons	15,161	127,477	13,839	108,751
Ferroalloys do	87,872	[b] 9,568,252	86,230	[b] 8,355,416
Garnet, abrasive short tons	7,662	583,190	7,428	623,472
Graphite, artificial pounds	26,761,015	[a b]	10,986,192	[a b]
Gypsum short tons	1,361,116	10,344,745	1,474,491	14,329,246
Iron ore:				
Sold to furnaces long tons	722,096	3,242,229	303,386	1,448,616
Sold for paint do	12,849	77,775	12,966	63,955
Iron, pig do	2,426,522	[b] 57,543,779	1,914,545	[b] 38,150,486
Lime short tons	100,862	1,037,737	98,592	991,799
Magnesium pounds	[a b]	[a b]	[a b]	[a b]
Marl, calcareous short tons	1,000	7,000	[a]	[a]
Mica, sheet pounds	[a]	[a]		
Millstones		14,344		18,215
Mineral waters gallons sold	6,716,154	803,433	[e]	[e]
Natural gas M cubic feet	6,497,000	3,739,000	6,196,000	3,632,000

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Exclusive of natural cement, value for which is included under "Miscellaneous."
[d] Figures obtained through cooperation with Bureau of the Census.
[e] No canvass for 1924.

Mineral production of New York in 1923 and 1924—Continued

Product	1923		1924	
	Quantity	Value	Quantity	Value
Natural-gas gasoline.....gallons	408,000	$44,000	477,000	$50,000
Peat.....short tons	862	7,545	508	7,438
Petroleum.....barrels	1,250,000	4,140,000	1,440,000	5,245,000
Pyrites.....long tons	11,000	[a]	7,593	16,705
Salt.....short tons	2,065,842	7,431,155	1,972,808	6,739,597
Sand and gravel.....do	10,730,225	7,291,076	13,397,540	8,583,193
Sand-lime brick.....thousands	[d] 15,646	[d] 204,433	[d] 16,529	[d] 220,851
Silica (quartz).....short tons	1,540	7,700	[a]	[a]
Slate.....		927,398		962,276
Stone.....short tons	7,043,880	9,610,324	7,557,320	10,981,814
Talc.....do	71,304	1,079,322	78,340	1,162,488
Zinc.....do	8,463	1,150,968	4,664	606,320
Miscellaneous [f]		19,304,748		25,468,760
Total value, eliminating duplications		89,975,134		95,435,299

[a] Value included under "Miscellaneous."
[d] Figures obtained through cooperation with Bureau of the Census.
[f] Includes minerals indicated by "[a]" and "[c]" above.

Mineral production of North Carolina in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Aluminum.....pounds	[a b]	[a b]	[a b]	[a b]
Barytes.....short tons	1,179	$7,076	[a]	[a]
Clay products.....		[c d] 3,656,452		[c] $4,000,431
Clay, raw.....short tons	23,793	[b] 369,518	16,966	[b] 277,526
Coal.....do	36,019	132,000	57,094	224,000
Copper.....pounds	61,983	9,112		
Feldspar (crude).....long tons	57,622	360,636	97,075	640,403
Garnet, abrasive.....short tons	[a]	[a]		
Gems and precious stones.....		[e]		[f]
Gold.....troy ounces	53	1,102	220	4,540
Iron ore.....long tons	59,684	161,603	12,525	32,512
Lime.....short tons	[a]	[a]	[a]	[a]
Marl, calcareous.....do	2,000	6,000	[a]	[a]
Mica:				
Scrap.....do	5,005	65,764	3,212	59,620
Sheet.....pounds	1,130,283	188,317	597,385	108,656
Millstones.....		[a]		1,615
Mineral waters.....gallons sold	74,745	7,840	[f]	[f]
Sand and gravel.....short tons	2,052,917	1,414,539	1,098,192	889,050
Sand and sandstone (finely ground).....do			[a]	[a]
Silica (quartz).....do	[a]	[a]	655	2,477
Silver.....troy ounces	78	64	31	21
Stone.....short tons	[g] 1,397,460	[g] 3,579,351	1,340,840	3,133,510
Talc and soapstone.....do	6,491	89,290	6,093	81,523
Miscellaneous [h]		6,511,903		7,604,509
Total value, eliminating duplications		10,020,559		9,261,467

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[d] Figures obtained through cooperation with Bureau of the Census.
[e] Exclusive of pottery, value for which is included under "Miscellaneous."
[f] Figures by States not available for 1923.
[g] No canvass for 1924.
[h] Exclusive of marble and unclassified stone, value for which is included under "Miscellaneous."
[h] Includes minerals indicated by "[a]," "[d]," and "[g]" above.

Mineral production of North Dakota in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a] $181,933		[a] $168,855
Clay, raw, short tons	29	[b] 384	26	[b] 440
Coal, do	1,385,400	3,275,000	1,200,527	2,473,000
Marl, calcareous, do			[c]	[c]
Mineral waters, gallons sold	[c]	[c]	[d]	[d]
Natural gas, M cubic feet	[c]	[c]	[c]	[c]
Sand and gravel, short tons	[c]	[c]	312,966	86,366
Miscellaneous [e]		16,085		7,256
Total value, eliminating duplications		3,473,018		2,735,477

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value not included in total value for State.
[c] Value included under "Miscellaneous."
[d] No canvass for 1924.
[e] Includes minerals indicated by "[c]" above.

Mineral production of Ohio in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asphalt (oil), short tons			500	[a] $9,064
Bromine, pounds	[b]	[b]	12,393	3,491
Calcium chloride, short tons	[b]	[b]	1,470	12,731
Cement, barrels	[a] 4,003,321	[c] $7,615,741	[a] 4,298,027	[c] 7,836,325
Clay products		[d] 99,078,987		[d] 97,831,641
Clay, raw, short tons	312,757	[a] 711,957	266,342	[a] 576,903
Coal, do	40,546,443	98,610,000	30,473,007	62,011,000
Coke, do	[c] 6,323,810	[c] 40,712,282	[c] 5,723,074	[c] 31,008,209
Ferroalloys, long tons	83,702	[a] 2,927,401	60,343	[a] 1,769,077
Grindstones and pulpstones, short tons	37,879	1,261,668	30,539	1,154,145
Gypsum, do	526,861	4,981,542	525,485	5,620,099
Iron ore, long tons			244	[b]
Iron, pig, do	8,964,805	[a] 222,009,553	7,434,487	[a] 159,701,131
Lime, short tons	867,982	8,740,688	934,407	9,511,270
Marl, calcareous, do	[b]	[b]		
Mineral paints, zinc and lead pigments, do	[a b]	[a b]	[a b]	[a b]
Mineral waters, gallons sold	2,693,541	182,604	[f]	[f]
Natural gas, M cubic feet	53,812,000	25,675,000	47,396,000	24,203,000
Natural-gas gasoline, gallons	10,035,000	1,446,000	9,443,000	1,148,000
Petroleum, barrels	7,085,000	17,050,000	6,811,000	17,165,000
Pyrites, long tons	138	505	73	[b]
Rubbing stones, scythestones, and whetstones, short tons	211	34,092	174	22,727
Salt, do	1,102,387	3,695,248	1,102,214	3,641,585
Sand and gravel, do	10,126,977	7,863,375	10,379,361	7,441,659
Sand-lime brick, thousands	[b d]	[b d]	[b d]	[b d]
Stone, short tons	11,493,340	11,464,569	10,455,060	11,280,865
Sulphuric acid [g], do			[a b]	[a b]
Miscellaneous [h]		2,973,589		5,357,573
Total value, eliminating duplications		287,868,728		249,049,648

[a] Value not included in total value for State.
[b] Value included under "Miscellaneous."
[c] Exclusive of natural cement, value for which is included under "Miscellaneous."
[d] Figures obtained through cooperation with Bureau of the Census.
[e] Exclusive of 149,796 tons of beehive coke in 1923 and 109,625 tons in 1924, value for which is included under "Miscellaneous," but not in total value for State.
[f] No canvass for 1924.
[g] From zinc smelting.
[h] Includes minerals indicated by "[b]," "[c]," and "[e]" above.

Mineral production of Oklahoma in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asphalt:				
Native, short tons	25,800	$150,100	17,961	$80,825
Oil, do	[a b]	[a b]	24,536	[b] 277,177
Cement, barrels	[a]	[a]	[a]	[a]
Chats, short tons	[c]	[c]	161,000	23,900
Clay products		[d] 1,870,436		[d] 1,963,484
Coal, short tons	2,885,038	10,874,000	2,329,615	8,590,000
Coke, do	[a b]	[a b]		
Gypsum, do	290,121	2,248,895	316,134	2,600,081
Lead, do	66,904	9,366,560	71,358	11,417,280
Lime, do	[a]	[a]	[a]	[a]
Manganese ore, long tons	[a]	[a]		
Mineral paints, zinc and lead pigments, short tons	[a b]	[a b]		
Mineral waters, gallons sold	996,564	34,562	[e]	[e]
Natural gas, M cubic feet	203,082,000	31,214,000	214,452,000	31,045,700
Natural-gas gasoline, gallons	270,249,000	23,012,000	301,062,000	23,338,000
Petroleum, barrels	160,929,000	279,700,000	173,538,000	272,450,000
Sand and gravel, short tons	1,404,185	974,461	1,846,268	894,455
Stone, do	[f] 1,265,900	[f] 1,427,920	[f] 1,303,030	[f] 1,499,297
Tripoli, do	[a]	[a]	[a]	[a]
Zinc, do	242,421	32,969,256	269,137	34,987,810
Miscellaneous [g]		5,160,576		4,139,833
Total value, eliminating duplications		398,810,630		393,030,665

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures not available.
[d] Figures obtained through cooperation with Bureau of the Census.
[e] No canvass for 1924.
[f] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "a" and "f" above.

Mineral production of Oregon in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Briquets, fuel, short tons	[a b]	[a b]	[a b]	[a b]
Cement, barrels	[a]	[a]	[a]	[a]
Chromite, long tons	78	$564	100	$200
Clay products		[c d] 612,785		[c d] 701,577
Clay, raw, short tons	1,101	[b] 2,833	134	[b] 512
Coal, do	[a]	[a]	[a]	[a]
Copper, pounds	1,283,476	188,671	768,395	100,660
Diatomaceous earth, short tons	[a]	[a]	[a]	[a]
Gems and precious stones		[e]		[f]
Gold, troy ounces	24,091	498,008	26,695	551,842
Gypsum, short tons	[a]	[a]	[a]	[a]
Lead, do	14	1,927	[a]	41
Lime, do	[a]	[a]	[a]	[a]
Mineral waters, gallons sold	3,058	588	[f]	[f]
Platinum and allied metals, troy ounces	77	11,952	15	2,073
Quicksilver, flasks	[a]	[a]	[a]	[a]
Sand and gravel, short tons	1,702,439	1,320,483	2,238,056	1,615,114
Silver, troy ounces	96,322	78,984	38,103	25,529
Stone, short tons	1,103,330	1,342,070	1,592,530	1,624,602
Miscellaneous [h]		2,719,693		3,392,044
Total value, eliminating duplications		6,054,487		7,364,232

[a] Value included under "Miscellaneous."
[b] Value not included in total value for State.
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Exclusive of pottery, value for which is included under "Miscellaneous."
[e] Figures by States not available for 1923.
[f] No canvass for 1924.
[g] 513 pounds.
[h] Includes minerals indicated by "a" and "d" above.

Mineral production of Pennsylvania in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Briquets, fuel ---- short tons	194, 973	[a] $1, 160, 254	93, 447	[a] $543, 399
Cement ---- barrels	[b] 38, 610, 852	[b] 69, 792, 343	[b] 40, 208, 860	[b] 69, 693, 517
Clay products		[c] 58, 529, 481		[c] 52, 167, 366
Clay, raw ---- short tons	517 392	[a] 1, 626, 882	661, 918	[a] 1, 942, 708
Coal:				
Anthracite ---- do	93, 339, 009	506, 786, 768	87, 926, 862	477, 230, 852
Bituminous ---- do	171, 879, 913	472, 217, 000	130, 633, 773	295, 164, 000
Coke ---- do	25, 624, 286	[a] 138, 444, 191	16, 927, 437	[a] 72, 568, 096
Copper ---- pounds	1, 703, 480	250, 411	1, 114, 694	146, 025
Feldspar (crude) ---- long tons	2, 069	6, 355	1, 481	4, 763
Ferroalloys ---- do	317, 470	[a] 28, 515, 265	260, 623	[a] 24, 618, 060
Gems and precious stones		[d]		[e]
Gold ---- troy ounces	157	3, 246	214	4, 424
Iron ore:				
Sold to furnaces ---- long tons	988, 586	2, 264, 485	807, 411	1, 881, 122
Sold for paint ---- do	3, 516	[f]	3, 005	[f]
Iron, pig ---- do	13, 898, 624	[a] 347, 679, 274	10, 962, 288	[a] 237, 052, 035
Lime ---- short tons	772, 839	6, 372, 732	700, 380	5, 634, 806
Mineral paints, zinc and lead pigments ---- do	[a f]	[a f]	[a f]	[a f]
Mineral waters ---- gallons sold	807, 522	84, 945	[e]	[e]
Natural gas ---- M cubic feet	112, 562, 000	45, 873, 000	105, 863, 000	45, 546, 000
Natural-gas gasoline ---- gallons	19, 132, 000	2, 560, 000	19, 254, 000	2, 266, 000
Peat ---- short tons	[f]	[f]	[f]	[f]
Petroleum ---- barrels	7, 609, 000	25, 320, 000	7, 486, 000	27, 025, 000
Potash (K_2O) ---- short tons	[f]	[f]	[f]	[f]
Sand and gravel ---- do	9, 221, 292	9, 944, 019	11, 315, 209	10, 927, 752
Sand and sandstone (finely ground) ---- do	[g]	[g]	[f]	[f]
Sand-lime brick ---- thousands	[c f]	[c f]	[c f]	[c f]
Silica (quartz) ---- short tons			[f]	[f]
Silver ---- troy ounces	3, 005	2, 464	2, 810	1, 883
Slate		5, 587, 670		5, 157, 868
Stone ---- short tons	[h] 15, 679, 170	[h] 18, 997, 295	[h] 14, 559, 490	[h] 17, 966, 836
Sulphuric acid (60° Baumé) [i] ---- do	[a c f]	[a c f]	118, 452	[a] 1, 072, 000
Talc ---- do	[f]	[f]	[f]	[f]
Tripoli (rottenstone) ---- do	[f]	[f]	[f]	[f]
Miscellaneous [j]		14, 544, 467		12, 891, 425
Total value, eliminating duplications		1, 225, 036, 404		1, 011, 630, 879

[a] Value not included in total value of State.
[b] Exclusive of natural cement, value for which is included under "Miscellaneous."
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] Value included under "Miscellaneous."
[g] Included under "Sand and gravel."
[h] Exclusive of serpentine, value for which is included under "Miscellaneous."
[i] From zinc smelting.
[j] Includes minerals indicated by "[b]," "[f]," and "[h]" above.

Mineral production of Rhode Island in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a b]		[a b]
Coke ---- short tons	[a c]	[a c]	[a c]	[a c]
Graphite, amorphous ---- do	3, 000	[a]	[a]	[a]
Lime ---- do	[a]	[a]	[a]	[a]
Mineral waters ---- gallons sold	277, 945	$26, 211	[d]	[d]
Sand and gravel ---- short tons	69, 714	36, 373	46, 378	$35, 932
Stone ---- do	[e] 161, 080	[e] 649, 359	[e] 171, 350	[e] 742, 701
Miscellaneous [f]		2, 315, 116		1, 480, 623
Total value, eliminating duplications		1, 022, 528		1, 132, 641

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] No canvass for 1924.
[e] Exclusive of limestone, value for which is included under "Miscellaneous."
[f] Includes minerals indicated by "[a]" and "[e]" above.

Mineral production of South Carolina in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Barytes—short tons	(a)	(a)	(a)	(a)
Clay products		[b c] $1,448,790		[b] $1,511,154
Clay, raw—short tons	55,048	[d] 454,412	41,544	[d] 421,713
Gold—troy ounces	15	313		
Marl, calcareous—short tons	(a)	(a)	(a)	(a)
Mica:				
Scrap—do	(a)	(a)	(a)	(a)
Sheet—pounds	(a)	(a)		
Mineral waters—gallons sold	121,576	25,078	(e)	(e)
Sand and gravel—short tons	581,048	336,109	743,746	364,977
Silver—troy ounces	1	1		
Stone—short tons	847,870	1,657,926	824,030	1,527,114
Miscellaneous [f]		81,842		41,121
Total value, eliminating duplications		3,550,059		3,444,366

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Exclusive of pottery, value for which is included under "Miscellaneous."
[d] Value not included in total value for State.
[e] No canvass for 1924.
[f] Includes minerals indicated by "a" and "c" above.

Mineral production of South Dakota in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide—short tons			83	$6,659
Clay products		(a b)		(a b)
Clay, raw—short tons	400	[c] $4,000	500	[c] 3,850
Coal—do	10,379	25,000	12,043	36,000
Columbite—pounds	1,350	540	1,197	598
Feldspar (crude)—long tons			(b)	(b)
Flint lining for tube mills—short tons			(b)	(b)
Gems and precious stones		(d)		(e)
Gold—troy ounces	309,905	6,406,306	295,930	6,117,421
Gypsum—short tons	(b)	(b)	(b)	(b)
Lime—do	(b)	(b)	(b)	(b)
Lithium minerals—do	(b)	(b)	(b)	(b)
Mica:				
Scrap—do	324	6,480	458	9,267
Sheet—pounds			(b)	(b)
Mineral waters—gallons sold	780,500	29,610	(e)	(e)
Natural gas—M cubic feet	33,000	16,600	3,000	2,500
Pebbles for grinding—short tons			(b)	(b)
Sand and gravel—do	304,768	156,914	323,303	113,602
Sand-lime brick—thousands	(a b)	(a b)	(a b)	(a b)
Silver—troy ounces	95,844	78,592	86,548	57,987
Stone—short tons	250,730	479,288	[f] 166,970	[f] 362,508
Tungsten ore (60 per cent concentrates)—do			(b)	(b)
Miscellaneous [g]		173,038		219,134
Total value, eliminating duplications		7,372,368		6,925,676

[a] Figures obtained through cooperation with Bureau of the Census.
[b] Value included under "Miscellaneous."
[c] Value not included in total value for State.
[d] Figures by States not available for 1923.
[e] No canvass for 1924.
[f] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[g] Includes minerals indicated by "b" and "f" above.

Mineral production of Tennessee in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Aluminum pounds	(a b)	(a b)	(a b)	(a b)
Barytes short tons	34, 384	$259, 005	39, 643	$302, 873
Bauxite long tons	(a)	(a)	(a)	(a)
Cement barrels	(a)	(a)	(a)	(a)
Clay products		c 4, 879, 848		c 4, 933, 152
Clay, raw short tons	105, 341	b 529, 551	145, 936	b 602, 091
Coal do	6, 040, 268	16, 515, 000	4, 556, 555	9, 711, 000
Coke do	304, 511	b 2, 069, 553	207, 475	b 1, 012, 064
Copper pounds	18, 721, 932	2, 752, 124	18, 335, 635	2, 401, 968
Ferroalloys long tons	19, 390	b 1, 424, 130	16, 192	b 1, 250, 902
Gold troy ounces	320	6, 615	329	6, 800
Iron ore:				
Sold to furnaces long tons	266, 175	677, 753	179, 293	431, 682
Sold for paint do	1, 100	(a)	560	(a)
Iron, pig do	215, 009	b 5, 793, 756	126, 660	b 2, 782, 154
Lead short tons	1, 250	175, 000	937	149, 920
Lime do	131, 995	1, 028, 158	144, 292	1, 111, 781
Manganese ore long tons	213	5, 611	455	11, 611
Mineral waters gallons sold	649, 348	41, 737	(d)	(d)
Natural gas M cubic feet	4, 100	1, 000	1, 200	450
Petroleum barrels	8, 000	14, 000	10, 000	18, 000
Phosphate rock long tons	415, 711	2, 255, 040	388, 697	1, 976, 188
Sand and gravel short tons	1, 868, 337	1, 253, 084	1, 942, 309	1, 483, 600
Silver troy ounces	105, 712	86, 684	94, 779	63, 502
Slate		(a)		(a)
Stone short tons	1, 454, 180	4, 341, 393	e 1, 437, 280	e 3, 867, 072
Sulphuric acid (60° Baumé) f do	(a b c)	(a b c)	288, 530	(a b)
Tripoli do			(a)	(a)
Zinc do	15, 900	2, 162, 400	14, 376	1, 868, 880
Miscellaneous g		11, 778, 544		14, 744, 149
Total value, eliminating duplications		41, 553, 789		35, 354, 525

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d No canvass for 1924.
e Exclusive of sandstone, value for which is included under "Miscellaneous."
f From copper smelting.
g Includes minerals indicated by "a" and "e" above.

Mineral production of Texas in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Asphalt:				
Native short tons	151, 356	$555, 533	220, 598	$779, 696
Oil do	243, 179	a 3, 781, 552	240, 903	a 4, 127, 663
Cement barrels	4, 091, 284	8, 011, 226	4, 488, 143	8, 322, 658
Clay products		b 5, 572, 665		b 5, 469, 908
Clay, raw short tons	3, 823	a 23, 873	3, 185	a 20, 006
Coal do	1, 187, 329	2, 162, 000	1, 147, 011	1, 721, 000
Copper pounds	4, 257	625		
Fuller's earth short tons	19, 465	186, 205	30, 279	313, 782
Gems and precious stones		(c)		(d)
Gold troy ounces	39	802		
Graphite, crystalline pounds	(e)	(e)	1, 215, 600	35, 042
Gypsum short tons	344, 104	2, 237, 024	402, 245	2, 629, 110
Lead do	13	1, 862		
Lime do	62, 822	606, 976	60, 565	570, 334
Mineral waters gallons sold	347, 973	61, 231	(d)	(d)
Natural gas M cubic feet	74, 535, 000	11, 320, 000	107, 247, 000	13, 748, 000
Natural-gas gasoline gallons	177, 765, 000	14, 752, 000	186, 571, 000	14, 460, 000
Petroleum barrels	131, 023, 000	193, 580, 000	134, 522, 000	203, 870, 000
Quicksilver flasks	(e)	(e)	(e)	(e)
Salt short tons	(e)	(e)	(e)	(e)
Sand and gravel do	5, 059, 601	2, 570, 994	5, 674, 651	2, 850, 955
Sand-lime brick thousands	(b e)	(b e)	(b e)	(b e)
Silver troy ounces	811, 824	665, 696	720, 739	482, 895
Stone short tons	2, 200, 690	2, 102, 281	2, 207, 050	1, 886, 798
Sulphur long tons	(e)	(e)	(e)	(e)
Miscellaneous f		16, 063, 793		15, 588, 845
Total value, eliminating duplications		260, 450, 913		272, 729, 023

a Value not included in total value for State.
b Figures obtained through cooperation with Bureau of the Census.
c Figures by States not available for 1923.
d No canvass for 1924.
e Value included under "Miscellaneous."
f Includes minerals indicated by "e" above.

Mineral production of Utah in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Arsenious oxide ---- short tons	5,027	$402,137	12,528	$1,002,281
Asphalt:				
Native ---- do	34,635	695,622	36,536	664,280
Oil ---- do			31,287	[a] 309,370
Cement ---- barrels	[b]	[b]	[b]	[b]
Clay products		[c] 936,701		[c d] 1,047,199
Clay, raw ---- short tons	4,250	[a] 15,300	10,419	[a] 33,367
Coal ---- do	4,720,217	13,657,000	4,488,157	12,057,000
Coke ---- do	232,941	[a] 1,977,669	257,094	[a b]
Copper ---- pounds	222,393,572	32,691,855	242,138,165	31,720,100
Diatomaceous earth ---- short tons			20	300
Fluorspar ---- do	188	3,196	184	3,292
Gems and precious stones		[e]		[f]
Gold ---- troy ounces	148,825	3,076,483	146,487	3,028,152
Gypsum ---- short tons	44,531	286,957	90,221	335,588
Iron ore ---- long tons	57,752	205,936	164,154	234,348
Iron, pig ---- do			[a b]	[a b]
Lead ---- short tons	101,724	14,241,346	116,955	18,712,870
Lime ---- do	12,228	152,136	12,853	172,434
Manganiferous ore ---- long tons			116	1,010
Marl, calcareous ---- short tons	[b]	[b]	[b]	[b]
Mineral paints, zinc and lead pigments ---- do	[a b]	[a b]		
Mineral soap ---- do			138	[b]
Petroleum ---- barrels			[b]	[b]
Platinum ---- troy ounces			1	118
Pumice ---- short tons	[b]	[b]	[b]	[b]
Salt ---- do	81,449	468,765	78,577	463,143
Sand and gravel ---- do	1,212,077	290,807	659,588	154,793
Sand and sandstone (finely ground) ---- do			[b]	[b]
Silica (quartz) ---- do	150	450	[b]	[b]
Silver ---- troy ounces	19,137,470	15,692,725	17,253,692	11,559,974
Stone ---- short tons	784,750	608,991	640,100	446,490
Sulphur ---- long tons	[b]	[b]		
Uranium and vanadium ores ---- short tons	[b]	[b]	[b]	[b]
Zinc ---- do	5,665	770,502	9,281	1,206,541
Miscellaneous [g]		2,083,114		4,537,889
Total value, eliminating duplications		86,221,000		84,356,626

[a] Value not included in total value for State.
[b] Value included under "Miscellaneous."
[c] Figures obtained through cooperation with Bureau of the Census.
[d] Exclusive of pottery, value for which is included under "Miscellaneous."
[e] Figures by States not available for 1923.
[f] No canvass for 1924.
[g] Includes minerals indicated by "[b]" and "[d]" above.

Mineral production of Vermont in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		[a b]		[a b]
Clay, raw ---- short tons	417	[c] $3,682	383	[c] $3,826
Lime ---- do	58,681	702,588	56,484	710,739
Mineral waters ---- gallons sold	[a]	[a]	[d]	[d]
Sand and gravel ---- short tons	55,551	18,793	131,453	34,795
Scythestones ---- do	[a]	[a]	[a]	[a]
Slate		3,857,287		4,010,346
Stone ---- short tons	342,520	8,661,906	[c] 295,880	[c] 9,066,073
Talc ---- do	67,100	533,510	61,653	573,747
Miscellaneous [f]		136,365		153,729
Total value, eliminating duplications		13,910,449		14,549,429

[a] Value included under "Miscellaneous."
[b] Figures obtained through cooperation with Bureau of the Census.
[c] Value not included in total value for State.
[d] No canvass for 1924.
[e] Exclusive of sandstone, value for which is included under "Miscellaneous."
[f] Includes minerals indicated by "[a]" and "[e]" above.

Mineral production of Virginia in 1923 and 1924

Product		1923		1924	
		Quantity	Value	Quantity	Value
Barytes	short tons	(a)	(a)	(a)	(a)
Briquets, fuel	do	(a b)	(a b)	(a b)	(a b)
Cement	barrels	(a)	(a)	(a)	(a)
Clay products			c $4,318,752		c $4,288,640
Clay, raw	short tons	14,303	b 128,071	14,466	b 121,249
Coal	do	11,761,643	32,468,000	10,693,464	21,823,000
Coke	do	774,887	b 5,086,612	485,064	b 2,343,081
Emery	do	(a)	(a)	(a)	(a)
Feldspar (crude)	long tons	(a)	(a)	(a)	(a)
Ferroalloys	do	(a b)	(a b)	(a b)	(a b)
Gold	troy ounces			6	116
Gypsum	short tons	(a)	(a)	(a)	(a)
Iron ore	long tons	200,966	664,240	91,759	250,279
Iron, pig	do	238,742	b 6,389,149	94,462	b 2,268,022
Lead	short tons			1,275	204,000
Lime	do	182,604	1,490,306	172,776	1,409,447
Manganese ore	long tons	987	42,020	1,565	59,220
Manganiferous ore	do	661	3,685	204	(a)
Marl, calcareous	short tons	36,937	87,714	28,940	74,059
Mica:					
Scrap	do	(a)	(a)	(a)	(a)
Sheet	pounds	(a)	(a)	(a)	(a)
Millstones			(a)		(a)
Mineral paints, zinc and lead pigments	short tons	(a b)	(a b)	(a b)	(a b)
Mineral waters	gallons sold	836,709	104,680	(d)	(d)
Pyrites	long tons	(a)	(a)	(a)	(a)
Salt	short tons	(a)	(a)	(a)	(a)
Sand and gravel	do	2,193,861	1,665,439	1,897,909	1,534,235
Sand and sandstone (finely ground)	do			(a)	(a)
Silver	troy ounces			3	2
Slate			e 321,010		e 336,627
Stone	short tons	2,216,140	2,482,937	2,223,620	2,566,575
Talc and soapstone	do	26,095	960,628	28,219	1,306,388
Titanium minerals:					
Ilmenite	do	466	(a)		
Rutile	do	270	(a)		
Zinc	do			2,664	346,320
Miscellaneous f			3,943,361		4,718,725
Total value, eliminating duplications			48,052,018		37,962,143

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d No canvass for 1924.
e Exclusive of granules, value for which is included under "Miscellaneous."
f Includes minerals indicated by "a" and "e" above.

Mineral production of Washington in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Briquets, fuel short tons	(a b)	(a b)	(a b)	(a b)
Cement barrels	2,111,479	$4,988,022	1,793,403	$4,236,554
Clay products		c 2,296,242		c 2,607,397
Clay, raw short tons	10,491	b 29,040	19,773	b 35,699
Coal do	2,926,392	10,894,000	2,653,667	9,689,000
Coke do	69,068	b 584,512	71,615	b 573,644
Copper pounds	871,999	128,184	928,458	121,628
Diatomaceous earth short tons	645	3,030	400	5,500
Gold troy ounces	16,547	342,067	14,978	309,617
Iron ore long tons			1,700	(a)
Lead short tons	1,453	203,454	1,968	314,830
Lime do	25,895	359,510	28,188	353,450
Magnesite do	73,900	165,100	52,860	139,600
Magnesium sulphate (natural) pounds	(a)	(a)	(a)	(a)
Manganese ore long tons			5,000	100,000
Mineral waters gallons sold	124,273	11,883	(d)	(d)
Pulpstones short tons	(a)	(a)	(a)	(a)
Rubbing stones do			(a)	(a)
Sand and gravel do	3,789,109	1,363,006	3,464,557	1,398,506
Silica (quartz) do	460	3,120	(a)	(a)
Silver troy ounces	227,187	186,293	213,742	143,207
Stone short tons	678,880	953,831	c 778,460	e 1,596,088
Zinc do	1,512	205,668	455	59,208
Miscellaneous f		740,354		778,597
Total value, eliminating duplications		22,169,191		21,159,370

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d No canvass for 1924.
e Exclusive of marble, value for which is included under "Miscellaneous."
f Includes minerals indicated by "a" and "e" above.

Mineral production of West Virginia in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Bromine pounds	140,060	$20,863	154,658	$39,139
Calcium chloride short tons	10,607	62,376	7,052	54,740
Cement barrels	(a)	(a)	(a)	(a)
Clay products		b 17,574,096		b 15,625,022
Clay, raw short tons	76,315	c 158,294	63,106	c 128,553
Coal do	107,899,941	285,481,000	101,662,897	185,229,000
Coke do	1,762,775	c 11,103,716	1,328,569	c 6,048,638
Ferroalloys long tons	(a c)	(a c)	(a c)	(a c)
Grindstones and pulpstones short tons	7,017	351,855	5,351	413,120
Iron, pig long tons	506,543	c 12,499,112	453,944	c 9,884,019
Lime short tons	241,601	2,029,061	238,714	1,884,682
Marl, calcareous do	(a)	(a)	17,686	53,058
Mineral waters gallons sold	478,520	70,447	(d)	(d)
Natural gas M cubic feet	203,867,000	69,981,000	182,285,000	68,000,000
Natural-gas gasoline gallons	63,381,000	8,890,000	61,549,000	7,154,000
Petroleum barrels	6,358,000	20,822,000	5,920,000	20,840,000
Salt short tons	31,589	284,196	37,561	258,089
Sand and gravel do	2,437,600	3,200,648	2,168,045	2,888,833
Sand and sandstone (finely ground) do	(e)	(e)	(a)	(a)
Stone do	2,550,710	2,660,415	2,618,290	3,040,154
Sulphuric acid f do	(a b c)	(a b c)	(a c)	(a c)
Miscellaneous g		2,304,249		2,878,278
Total value, eliminating duplications		412,866,535		307,314,205

a Value included under "Miscellaneous."
b Figures obtained through cooperation with Bureau of the Census.
c Value not included in total value for State.
d No canvass for 1924.
e Included under "Sand and gravel."
f From zinc smelting.
g Includes minerals indicated by "a" above.

Mineral production of Wisconsin in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Barytes, short tons	(a)	(a)	(a)	(a)
Briquets, fuel, do	(a b)	(a b)	(a b)	(a b)
Cement, barrels			(a)	(a)
Clay products		c d $1,058,138		c d $1,063,164
Clay, raw, short tons	122	b 397	237	b 883
Coke, do	(a b)	(a b)	(a b)	(a b)
Iron ore:				
Sold to furnaces, long tons	831,412	2,421,194	786,006	2,044,762
Sold for paint, do	2,990	4,680	1,113	(a)
Iron, pig, do	280,457	b 7,264,981	172,435	b 3,945,369
Lead, short tons	734	102,760	1,254	200,640
Lime, do	227,549	2,055,646	235,030	2,129,701
Manganiferous ore, long tons	353,046	(a)	175,316	606,593
Marl, calcareous, short tons	(a)	(a)	(a)	(a)
Mineral paints, zinc and lead pigments, short tons	(a b)	(a b)	(a b)	(a b)
Mineral waters, gallons sold	6,977,448	2,612,452	(e)	(e)
Pyrites, long tons	190	903	121	484
Sand and gravel, short tons	5,021,608	2,793,999	5,713,956	2,703,475
Sand-lime brick, thousands	(a c)	(a c)	(a c)	(a c)
Silica (quartz), short tons	(a)	(a)	(a)	(a)
Stone, do	2,488,180	4,590,528	f 2,221,910	f 4,087,133
Sulphuric acid g, do			(a b)	(a b)
Zinc, do	13,211	1,796,696	14,027	1,823,510
Miscellaneous h		12,932,430		9,484,734
Total value, eliminating duplications		19,089,600		15,796,720

a Value included under "Miscellaneous."
b Value not included in total value for State.
c Figures obtained through cooperation with Bureau of the Census.
d Exclusive of pottery, value for which is included under "Miscellaneous."
e No canvass for 1924.
f Exclusive of basalt, value for which is included under "Miscellaneous."
g From zinc smelting.
h Includes minerals indicated by "a," "d," and "f" above.

Mineral production of Wyoming in 1923 and 1924

Product	1923		1924	
	Quantity	Value	Quantity	Value
Clay products		a $136,493		a $126,606
Clay, raw, short tons	614	b 10,448	23,716	b 41,172
Coal, do	7,575,031	20,916,000	6,757,468	18,327,000
Copper, pounds	111,280	16,358		
Gold, troy ounces	14	296		
Gypsum, short tons	33,644	176,791	32,715	190,344
Iron ore, long tons	378,747	(c)	363,056	(c)
Lime, short tons	(c)	(c)	(c)	(c)
Mica, scrap, do	100	2,000		
Mineral waters, gallons sold	(c)	(c)	(d)	(d)
Natural gas, M cubic feet	35,523,000	4,222,000	46,036,000	4,081,000
Natural-gas gasoline, gallons	21,292,000	1,992,000	29,272,000	2,979,000
Petroleum, barrels	44,785,000	48,900,000	39,498,000	48,600,000
Phosphate rock, long tons	250	1,000	1,250	5,600
Platinum and allied metals, troy ounces	(c)	(c)		
Sand and gravel, short tons	1,377,271	403,911	615,163	173,886
Silver, troy ounces	254	208		
Sodium salts (carbonate and sulphate) from natural sources, short tons	(c)	(c)	(c)	(c)
Stone, do	e 186,150	e 281,595	234,620	354,057
Miscellaneous f		615,895		656,673
Total value, eliminating duplications		77,664,547		75,494,166

a Figures obtained through cooperation with Bureau of the Census.
b Value not included in total value for State.
c Value included under "Miscellaneous."
d No canvass for 1924.
e Exclusive of sandstone and unclassified stone, value for which is included under "Miscellaneous."
f Includes minerals indicated by "c" and "e" above.

PREFATORY NOTE TO THE REPORTS ON GOLD, SILVER, COPPER, LEAD, AND ZINC

By Frank J. Katz

Chief Engineer, Division of Mineral Resources and Statistics

In the mining industry, gold, silver, copper, lead, and zinc are closely related in both the genesis and the geologic occurrence of their ores, as well as in mining and in metallurgical treatment. Of their ores some contain all five metals, many contain three or four, and few contain only one. Gold and silver, for instance, almost everywhere show close genetic relations, and their ores are usually mined together. Lead and zinc constitute a similar pair. Copper ores almost invariably yield some silver and gold as well as copper, and most lead ores yield notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. All five metals may occur in commercial quantity in a single mine or, more commonly, in a single mining district. For these reasons each of these metals is treated in Mineral Resources in a general report, and all five metals are grouped together in "mine reports" descriptive of individual or geographically grouped States. These reports are printed in 15 pamphlets.

To facilitate advance publication each report is published separately at the earliest date possible. The general reports give figures of the output of the metals in the first marketable form, as obtained from the smelters, refineries, and mints, together with general reviews of the respective industries for the entire country. The figures given in the general reports represent the final official statistics of production for the country and of the States. The general report on gold and silver includes the statistics of recovered precious metals as determined by the Bureau of the Mint. The "mine reports" give figures of the production (called "mine production") as obtained from the mines, so far as possible in terms of recoverable metal in ores and other material sold or treated during the year; they also supply information in detail relative to the mining industry in the respective States, counties, and mining districts.

These reports, which appear as separate chapters in this volume, are as follows:

Gold and silver (general report).
Copper (general report).
Lead (general report).
Zinc (general report).
Gold, silver, copper, lead, and zinc in the Eastern States (mine report).
Silver, copper, lead, and zinc in the Central States (mine report).
Gold, silver, copper, lead, and zinc in Arizona (mine report).
Gold, silver, copper, lead, and zinc in California and Oregon (mine report).

Gold, silver, copper, lead, and zinc in Colorado (mine report).
Gold, silver, copper, lead, and zinc in Idaho and Washington (mine report).
Gold, silver, copper, lead, and zinc in Montana (mine report).
Gold, silver, copper, lead, and zinc in Nevada (mine report).
Gold, silver, copper, lead, and zinc in New Mexico and Texas (mine report).
Gold, silver, copper, and lead in South Dakota and Wyoming (mine report).
Gold, silver, copper, lead, and zinc in Utah (mine report).

In stating quantity of ores, concentrates, and similar material the short ton of 2,000 pounds is used throughout. The term "ore" as used here denotes any metalliferous material treated at the mine or shipped to reduction plants and paid for by those plants, whether or not it nets a profit to the miner. The ore classification is necessarily arbitrary, because of the varying factors affecting mining and treatment of ores. Dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores that carry considerable quantities of iron and manganese oxides and very small quantities of gold and silver and also gold and silver ores that carry copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The copper ores include the great disseminated copper deposits of the West, the copper ores of the Lake Superior region, and other ores in which copper is the most abundant base metal paid for. The lead and zinc ores are those in which lead or zinc is the only or chief base metal present, irrespective of their precious-metal content. The mixed ores are those whose commercial value depends on the recoverable or recovered contents of two or more base metals in addition to any precious metals they may contain. If one of the metals, though present in sufficient quantity, is not recovered, that metal is disregarded in naming the ore. An improvement in metallurgy may later serve to change the name of such ore. The classification based on methods of treatment is the only satisfactory commercial classification.

It is to be understood, of course, that market values are not received by producers for metals in ore and intermediate products nor always for metals in marketable form, that payment is made in accordance with contracts for treatment or sale, and therefore that average daily quotations do not necessarily agree with average prices received.

Prices of silver, copper, lead, and zinc, 1850–1924

Year	Silver [a]	Copper [b]	Lead [c]	Zinc [d]	Year	Silver [a]	Copper [b]	Lead [c]	Zinc [d]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1850	$1.32	$0.22	$0.05		1888	$0.94	$0.168	$0.044	$0.049
1851	1.34	.166	.05		1889	.94	.135	.039	.05
1852	1.33	.22	.05		1890	1.05	.156	.045	.055
1853	1.35	.22	.06	$0.055	1891	.99	.128	.043	.05
1854	1.35	.22	.06		1892	.87	.116	.041	.046
1855	1.34	.27	.07		1893	.78	.108	.037	.04
1856	1.34	.27	.066		1894	.63	.095	.033	.035
1857	1.35	.25	.06		1895	.65	.107	.032	.036
1858	1.34	.23	.06		1896	.68	.108	.03	.039
1859	1.36	.22	.055		1897	.60	.12	.036	.041
1860	1.35	.23	.056		1898	.59	.124	.038	.046
1861	1.33	.22	.05		1899	.60	.171	.045	.058
1862	1.35	.22	.06		1900	.62	.166	.044	.044
1863	1.345	.34	.06		1901	.60	.167	.043	.041
1864	1.345	.47	.07	.139	1902	.53	.122	.041	.048
1865	1.337	.392	.066		1903	.54	.137	.042	.054
1866	1.339	.342	.07		1904	.58	.128	.043	.051
1867	1.33	.254	.065		1905	.61	.156	.047	.059
1868	1.326	.23	.065		1906	.68	.193	.057	.061
1869	1.325	.242	.06		1907	.66	.20	.053	.059
1870	1.328	.212	.06		1908	.53	.132	.042	.047
1871	1.325	.241	.06		1909	.52	.13	.043	.054
1872	1.322	.356	.064		1910	.54	.127	.044	.054
1873	1.297	.280	.06		1911	.53	.125	.045	.057
1874	1.278	.220	.06		1912	.615	.165	.045	.069
1875	1.24	.227	.058	.07	1913	.604	.155	.044	.056
1876	1.16	.21	.061	.072	1914	.553	.133	.039	.051
1877	1.20	.19	.055	.06	1915	.507	.175	.047	.124
1878	1.15	.166	.036	.049	1916	.658	.246	.069	.134
1879	1.12	.186	.041	.052	1917	.824	.273	.086	.102
1880	1.15	.214	.05	.055	1918	1.00	.247	.071	.091
1881	1.13	.182	.048	.052	1919	1.12	.186	.053	.073
1882	1.14	.191	.049	.053	1920	1.09	.184	.08	.081
1883	1.11	.165	.043	.045	1921	1.00	.129	.045	.05
1884	1.11	.13	.037	.044	1922	1.00	.135	.055	.057
1885	1.07	.108	.040	.043	1923	.82	.147	.07	.068
1886	.99	.111	.046	.044	1924	.67	.131	.08	.065
1887	.98	.138	.045	.046					

[a] Report of Director of the Mint, pp. 212–213, 1914. Equivalent value of fine ounce based on average price and average rate of exchange. For 1916, 1917, and 1919, dealers' buying price, New York. For 1918, average price as stated by the Bureau of the Mint. For 1920, 1921, and 1922, New York market price for domestic silver only. For 1923 and 1924, average price under Pittman Act, from Jan. 1 to June 2, 1923, for domestic silver; average New York price for all silver after that period.

[b] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850–1860, p. 1339. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years, average price all marketable grades.

[c] New York price, Ingalls, W. R., Lead and zinc in the United States, p. 203, 1908. U. S. Geological Survey since 1904. For 1916, outside spot quotations, New York. For 1917 and later years, average price all grades.

[d] New York price, 1875–1904, Ingalls, W. R., Lead and zinc in the United States, p. 342, 1908. St. Louis price, U. S. Geological Survey, since 1904. For 1915 and later years, average price all grades. Oral communication from C. E. Siebenthal, of the U. S. Geological Survey, for 1853 and 1864.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES[1]

By J. P. Dunlop

MINE PRODUCTION

The total value of the gold, silver, copper, lead, and zinc mined in the Eastern States in 1924 showed an increase of 10 per cent from the corresponding value in 1923. Of the total value, gold represented $16,535; silver, $65,411; copper, $2,547,993; lead, $353,920; and zinc, $16,875,606. The increase was caused almost entirely by the larger output of zinc and lead, as the production of gold continued small and that of copper and silver was substantially less in 1924 than in 1923.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1923–24

Year	Number of mines	Ore sold or treated	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1923	21	2,936,637	$11,919	108,799	20,487,395	2,500,000	199,180,000	$18,053,666
1924	16	2,851,932	16,535	97,628	19,450,329	4,424,000	212,148,000	19,859,465

GOLD AND SILVER

Of the mine output of gold in 1923 placers yielded only $193, the smallest yield for many years, siliceous ores $5,118, and copper and magnetite ores $11,224.

The deep and placer gold mines, which have produced nearly all the gold in the Eastern States, supplied only 32 per cent in 1924, and of these one deep mine produced more gold than the other six deep and placer mines combined. The output of siliceous ore increased considerably, though only one mill was operated on ore derived other than incidentally from development work. Not only were fewer gold mines, both placer and deep, operated in 1924, but less development work was accomplished than usual. Lack of available capital hampered the working of many properties, and scarcity of labor, high costs, and low-grade ore were contributing reasons for the almost total cessation of active gold mining in many districts in the South.

The gold obtained in refining copper bullion from Tennessee and Pennsylvania has been the only uninterrupted source of gold in the Eastern States in the last six years.

[1] U. S. Geol. Survey Mineral Resources, 1908, pt. 1, pp. 645–681, contains references to the geology of the several States and gives a list of the Geological Survey, State survey, and other publications relating to the geology and mines in all the Eastern States; and U. S. Geol. Survey Mineral Resources, 1914, pt. 1, pp. 139–163, contains a historical review of the production of gold in the Southern Appalachian States and a list of Survey publications on gold, silver, copper, lead, and zinc in the Eastern States.

The value of the estimated gold production of the Southern Appalachian States for the period 1799–1924 is $51,076,216.

All the output of silver in 1924 was derived from copper ore and pyritiferous magnetite ore except 39 ounces derived from placer bullion and siliceous ore.

Mine production of gold and silver in the Eastern States in 1924, by States

State	Gold		Silver		Increase or decrease in value as compared with 1923	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver
Alabama					—$114	—$1
Georgia	31.68	$655	5	$3	+126	+2
North Carolina and South Carolina [a]	219.63	4,540	31	21	+3,125	—44
Pennsylvania	214.01	4,424	2,810	1,883	+1,178	—581
Tennessee	328.95	6,800	94,779	63,502	+185	—23,182
Virginia	5.61	116	3	2	+116	+2
	799.88	16,535	97,628	65,411	+4,616	—23,804
Total, 1923	576.58	11,919	108,799	89,215		

[a] No production from South Carolina in 1924.

Mine production of gold and silver in the Eastern States in 1924, by sources, in fine ounces

State	Gold			Silver		
	Placers	Dry and siliceous ore	Copper ore	Placers	Dry and siliceous ore	Copper ore
Georgia	3.77	27.91			5	
North Carolina	5.57	214.06		1	30	
Pennsylvania			214.01			2,810
Tennessee			328.95			94,779
Virginia		5.61			3	
	9.34	247.58	542.96	1	38	97,589
Total, 1923	49.34	21.18	506.06	4	4	108,791

COPPER

The mine production of copper in the Eastern States in 1924 was valued at $2,547,993, a decrease of $463,654. The entire output was derived from Tennessee copper ore and from Pennsylvania pyritiferous magnetite ore.

The quantity of ore treated to produce this copper was 1,399,675 short tons. Exclusive of the magnetite ore, which was mined for its iron content and contained very little copper, the average yield of copper from copper ore was approximately 1.28 per cent, or 25.6 pounds to the ton, and this copper ore also yielded $0.098 in gold and silver to the ton.

The copper concentrates from the magnetite ore contained about 3.83 per cent of copper and a small quantity of gold and silver.

Copper ore directly smelted amounted to 410,236 tons, from which about 11,240,587 pounds of copper was recovered. Copper and magnetite ore concentrated amounted to 989,439 tons, which yielded 49,242 tons of concentrates containing 8,209,742 pounds of copper.

LEAD

The only shipments of lead reported to the Survey were made by mines in Tennessee and Virginia, though it is stated that a few tons of lead ore was mined at the old Chipman mine, in Massachusetts, and was treated at a small smelter owned by the mine operators.

ZINC

The recoverable zinc in the ore mined in the Eastern States in 1924 was valued at $16,875,606,[2] an increase of $2,109,721. Zinc ore mined in New Jersey, Tennessee, and New York amounted to 1,374,759 tons—610,944 tons from New Jersey, 723,465 tons from Tennessee, and 40,350 tons from New York. All the zinc ore from New York and Tennessee was sent to concentrating plants, and of the zinc ore from New Jersey 553,701 tons was concentrated and the remainder was shipped as crude ore. In Virginia 70,709 tons of lead-zinc ore was concentrated, yielding both lead and zinc concentrates, which were shipped to smelters. The recoverable quantity of zinc from New York in 1924 was 9,328,000 pounds, from Tennessee 28,752,000 pounds, and from Virginia 5,328,000 pounds.

REVIEW BY STATES

Alabama.—The value of the gold produced by mines in Alabama during the period 1830 to 1924 was $766,746. None was reported in 1924. Old properties, such as the Gold Log and Gold Ridge, were idle, and the placer mines at Arbacoochee were not prospected or developed.

Georgia.—The value of the gold produced in Georgia during the period 1830 to 1924 was $17,830,374, or more than one-third of the estimated total output of the Southern Appalachian States.

In 1924 mines in Georgia produced $655 in gold and 5 ounces of silver, slightly more than in 1923. The gold and silver was obtained from prospect work, and little ore was milled. Most of the output came from the Dahlonega district, in Lumpkin County, where development work was done at the Findley, Crown Mountain, Standard, and Turkey Hill mines. A little placer gold was reported from the Villa Rica district, in Douglas County. It is expected that the 900-foot tunnel at the Turkey Hill mine, Dahlonega, will be completed in 1925. The Pine Mountain placer plant, at Villa Rica, was being repaired for operating. The Parks mine, in McDuffie County, now owned by the Cambria Mining Co., was under development, and the shaft was sunk 160 feet.

Maine, Maryland, New Hampshire, and Vermont.—No production of gold, silver, or copper was reported in 1924 by mines in Maine, Maryland, New Hampshire, or Vermont. The estimated total gold production of Maryland has been $71,405, none of which has been produced in the last 12 years.

Massachusetts.—The old Chipman mine, at Highfield, Essex County, Mass., was operated in the early part of 1924 by the United Metals Separation & Refining Co., which reopened the mine and

[2] It must be distinctly understood that the value of the zinc in New Jersey is not that of ore mined. It is the estimated smelter value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing are added.

erected a small reduction plant. A small quantity of lead bullion was produced, but it was not shipped or sold. The mine and reduction plant were closed for the remainder of the year. A brief but comprehensive description of the workings of the mine and the character of the ore, by G. F. Loughlin, is contained in the chapter on gold, silver, copper, lead, and zinc in the Eastern States in Mineral Resources for 1919. Some records of operations from 1872 to 1921 are given in an article by Frederick E. Green.[3]

New Jersey.[4]—The production of zinc ore in New Jersey in 1924 amounted to 610,944 tons, which contained 168,740,000 pounds of recoverable zinc. The crude ore produced in 1923 amounted to 548,891 tons and contained 150,454,000 pounds of recoverable zinc.[5] Figures showing the value of the crude ore mined are not available.

New York.—The quantity of zinc ore and tailings from New York treated in 1924 was 40,350 tons. The concentrates shipped in 1924 contained 9,328,000 pounds of recoverable zinc. The New York Zinc Co., operating the Brown mine, near Edwards,[6] St. Lawrence County, treated most of this ore. One shaft was operated in 1924. Several thousand tons of pyrite concentrates were sold in 1924. Ore extracted from levels at 800 to 900 feet is dropped to the 900-foot level, hoisted, and trammed by means of a gasoline motor to the mill. The mill, which is constructed of steel and tile, is equipped with crusher, rolls, Dorr thickener, and 17 tables and has a daily capacity of 250 tons. The table concentrates are treated by 13 Electric Ore Separating Co. machines, which, by removing most of the pyrite, raise the zinc content to 46 to 48 per cent. The average zinc assay of the crude ore treated ranges from 13 to 20 per cent (the average zinc content of the ore in 1924 was 17.25 per cent). The plant for the treatment of tailings was operated in 1924. It is estimated that the mine has about 700,000 tons of ore reserves averaging about 20 per cent in zinc content.

North Carolina.—The value of the gold produced in North Carolina during the period 1799 to 1924 was $23,639,901. There was an increase in the gold output from $1,102 in 1923 to $4,540 in 1924, though only a few mines were operated and the increase was due entirely to the working of the old Coggins mine, near Eldorado, in Montgomery County. This mine is opened by an inclined shaft 550 feet long and by about 3,000 feet of drifts. The ore is treated by amalgamation at a 50-stamp mill, equipped with Wilfley tables, to save the concentrates. Many improvements, including electric hoists and lighting plant, were made at the property in 1924, from which bullion was not shipped until December.

None of the deep mines in Moore, Davidson, Rowan, or Cabarrus counties made any production in 1924, and the small placer yield of gold came from the Rutherfordton district.

Pennsylvania.—The Cornwall iron mines, in Lebanon County, Pa., were operated as usual by the Bethlehem Steel Co. and yielded several thousand tons of a low-grade copper concentrate from pyritiferous magnetite ore. The crude ore is taken from an open pit by means of an incline, and the copper is recovered on Wilfley tables. The

[3] Vicissitudes of silver mining at Newburyport, Mass.: Eng. and Min. Jour.-Press, March 17, 1923, p. 483.
[4] Spurr, J. E., and Lewis, J. V., Ore deposition at Franklin Furnace, N. J.: Eng. and Min. Jour.-Press, February 21, 1925, pp. 317–328.
[5] See footnote 2, p. 3.
[6] Wade, W. R., The business side of black-jack zinc mining: Eng. and Min. Jour.-Press, January 10, 1925, pp. 72–73.

concentrate, which was shipped to smelters, contained about 32 per cent of sulphur, 3.83 per cent of copper, and small quantities of gold and silver. Some prospect work was done in 1924 by the Guerden Glen Lead Mining Co., of Doylestown, Pa., on land in New Britain Township, Bucks County.

South Carolina.—Mines in South Carolina produced $5,182,305 in gold during the period 1829 to 1924. No production of gold or silver in 1924 was reported from the placers or deep mines in Lancaster, Spartanburg, or York counties, and very little development work was done.

Tennessee.—The gold produced in Tennessee during the period 1831 to 1924 amounted to $287,337. Most of the output prior to 1879 was derived from placer mines, but the production since 1906 has been recovered entirely from copper ore mined in Polk County. The total value of metals mined in Tennessee decreased in 1924. There was a nominal increase in the output of gold, but that of copper, silver, lead, and zinc decreased both in quantity and in value.

Mine production of gold, silver, copper, lead, and zinc in Tennessee, 1905–1924

Year	Ore sold or treated	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1905–1914	6,401,574	$57,630	808,443	182,379,746		42,662,808	$30,483,771
1915	1,149,364	6,862	100,543	18,046,010	1,660	32,922,902	7,298,406
1916	1,184,821	5,739	94,701	14,679,794	32,960	52,855,480	10,764,189
1917	1,533,983	5,326	99,053	16,033,749	5,061,937	56,995,107	10,712,985
1918	1,159,971	4,866	93,620	14,799,680	3,410,400	42,141,311	7,831,005
1919	1,227,534	5,662	98,288	15,623,589	4,376,000	46,494,000	6,647,723
1920	1,120,995	5,830	110,719	16,727,803	3,957,000	38,434,000	6,634,144
1921	889,122	4,920	98,762	15,084,294		19,384,000	3,018,756
1922	983,844	4,320	78,341	14,240,571	1,464,000	31,136,000	3,860,410
1923	1,355,547	6,615	105,712	18,721,932	2,500,000	31,800,000	5,182,823
1924	1,443,159	6,800	94,779	18,335,635	1,874,000	28,752,000	4,491,070
	18,449,914	114,570	1,782,961	344,672,803	22,677,957	423,577,608	96,925,282

The entire output of copper, gold, and silver in Tennessee came from the two large copper mines in the Ducktown district, and the production of copper and silver was less in 1924 than in 1923. The Tennessee Copper Co. operated its flotation plant, 2,000-ton smelter, converter, sulphuric acid plant, and copper sulphate plant on crude sulphide ore from the Burra Burra and London mines. The pig copper was shipped to the Nichols Copper Co. for refining.

The Ducktown Sulphur, Copper & Iron Co. operated one 600-ton blast furnace and 12-foot converter on self-fluxing sulphide ore and concentrates from the Mary mine, at Ducktown. Part of the crude ore was concentrated at the 500-ton flotation plant. The Mary mine is opened by a 1,200-foot vertical shaft, and the East Tennessee mine by a 700-foot shaft.

Most of the zinc produced was obtained from the Embree mine, in Washington County, and the Mascot mine, in Jefferson County, as the mines of the Union Zinc Co., in Union County, of the Tennessee Zinc Co., in Claiborne County, and of the Grasselli Zinc Co., in Jefferson County, were idle. The Embree Iron Co. operated the Embree mine, which produces zinc carbonate and lead carbonate ores. Part of the zinc ore is shipped directly from the mines, and part is concentrated by means of log washers and tables. The dried

crude zinc ore and concentrates contained 43.2 per cent of zinc. Some galena ore was concentrated by means of jigs and tables into a product averaging about 62.73 per cent of lead.

The American Zinc Co. of Tennessee continued its steady operation of the Mascot mine. The sulphide ore was hoisted from the mine through the 180-foot and 700-foot shafts. The concentrating plant is equipped with Cooley jigs, tables, and oil flotation and has a capacity of 125 tons an hour. The new Oliver filter and Lowden patent dryer for drying flotation concentrates was operated in 1924.

Virginia.—The value of gold produced from mines in Virginia during the period 1828 to 1924 was $3,298,148, of which only about $9,000 was recovered during the last 14 years. The deep and placer gold mines in Albemarle, Floyd, Fauquier, Goochland, and Fluvanna counties yielded about half of this total; the remainder of the gold was derived from cinders of pyritic ore or copper ore shipped to smelting plants.

Mines in Virginia produced in 1924 5.61 ounces of gold, 3 ounces of silver, 1,275 tons of lead, and 2,664 tons of zinc, having a total value of $550,438. At the Twin Vein mine, near Mineral, in Louisa County, some development work done late in 1924 yielded a small quantity of bullion, which was shipped to the Mint at Philadelphia. No gold or silver was reported from the smelting of pyritic ore in 1923 or 1924.

CADMIUM[1]

By C. E. Siebenthal and A. Stoll

THE CADMIUM INDUSTRY

The production of cadmium in the United States began in a small way in 1906 and grew steadily until 1917, when the maximum output was reached. Cadmium is sold as the metal, principally in sticks, ingots, or slabs, and as the pigment cadmium sulphide, but it is also sold as the compounds cadmium oxide and cadmium hydrate, for use in the udylite process of cadmium electroplating. A small quantity of cadmium carbonate and of cadmium lithopone was made in 1924. The udylite process, which was described in Mineral Resources for 1922 and which is controlled by the Udylite Process Co., of Kokomo, Ind., continues to make headway. Some 80 licensed plants for rust-proofing iron and steel by this process are now using about 50 tons of metallic cadmium annually in commercial plating. The present low price of the metal will probably induce extensions of this and other uses.

PRODUCTION

There are several cadmium minerals, but none of them occur in quantities large enough to be called ores. The cadmium of commerce is derived from zinc minerals and ores, in practically all of which it occurs in minute quantity, the ratio being about 1 of cadmium to 200 of zinc. Cadmium behaves metallurgically almost the same as zinc and hence constitutes a fraction of 1 per cent of almost all metallic zinc, except that made electrolytically and that made from certain cadmium-free ore. The sources of cadmium that have been utilized are zinc ores treated by fractional distillation, lead-furnace baghouse "fumes" (the cadmium content of which is derived from the zinc minerals contained in the charge of lead ore), and residues from the purification vats of electrolytic zinc plants and lithopone plants. The production of cadmium, either as metal or in compounds, was reported by the companies in the following list, which shows also the nature of the metallurgic plant in connection with which the cadmium is recovered, and the companies selling cadmiferous residues.

[1] A more complete account of the production, resources, metallurgy, and uses of cadmium was given in Mineral Resources for 1908. Another account describing in some detail the cadmium-bearing by-products produced in the United States and their possibilities as commercial sources of cadmium and giving the results of attempts to substitute cadmium for tin in solders was included in Mineral Resources for 1918. A statement of the commercial standards of quality, with typical analyses, is given in the chapter on cadmium in Mineral Resources for 1921.

Producers of cadmium in the United States in 1923–24

Company	Location of plant	Associated plant
American Smelting & Refining Co	Denver, Colo	Lead smelter.
Anaconda Copper Mining Co	Great Falls, Mont	Electrolytic zinc plant.
Chemical & Pigment Co	St. Helena, Md	Lithopone plant.
Grasselli Chemical Co	Cleveland, Ohio	Chemical works and lithopone plant.
International Smelting Co.[a]	Tooele, Utah	Lead smelter.
Krebs Pigment & Chemical Co.[a]	Newport, Del	Lithopone plant.
Midland Chemical Co	Argo, Ill	Do.
New Jersey Zinc Co	Palmerton, Pa	Do.
United Color & Pigment Co.[a]	Newark, N. J	Do.
United States Smelting, Refining & Mining Co	Midvale, Utah	Lead smelter.

[a] Disposed of cadmiferous residues to producers of metallic cadmium or cadmium products.

Several years ago the Anaconda Copper Mining Co. worked out experimentally a method to recover the cadmium precipitated in purifying the zinc solution for electrolysis at the Great Falls plant. It began the production of metallic cadmium in a commercial way early in 1923 and promises to be an important producer.

As noted in Mineral Resources for 1922, the cadmium market was more or less demoralized by the entrance of producers of large capacity. In the present unstable state of the cadmium industry the Geological Survey is unable to obtain for publication the complete figures of production and sales of cadmium in the several forms other than metallic cadmium.

Metallic cadmium and cadmium sulphide produced in the United States, 1919–1924

Year	Metallic cadmium			Cadmium sulphide		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
1919	99,939	$121,926	$1.22	31,197	$37,436	$1.20
1920	129,283	151,261	1.17	32,133	37,274	1.16
1921	68,501	67,131	.98	65,446	71,336	1.09
1922	131,590	143,433	1.09	134,774	152,295	1.13
1923	183,816	161,758	.88	[a]	[a]	[a]
1924	129,328	77,597	.60	[a]	[a]	[a]

[a] Figures showing the quantity and value of cadmium sold in the form of compounds are not available for publication. The statistics of output and value of metallic cadmium and cadmium sulphide from the beginning of the industry in the United States to 1922 will be found in Mineral Resources for that year.

WORLD'S PRODUCTION OF CADMIUM

The following table, prepared by W. I. Whiteside, of the United States Geological Survey, shows the known production of metallic cadmium by the world for the last few years. Silesia has a long history of cadmium production, but in Australia the industry has just been started. As no figures of production in England or France are available, it has been necessary to take the reported exports of domestic metal for those countries. Small exports of cadmium from Belgium are reported in the trade press, but there are no official figures.

World's production of metallic cadmium, 1914–1924, by countries, in pounds avoirdupois

Year	Australia (Tasmania)		France [a]		Great Britain [a]		United States		Upper Silesia	
	Quantity	Average value [b]	Quantity	Average value (francs [c])	Quantity	Average value [b]	Quantity	Average value	Quantity	Average value (marks [c])
1914			661	4.56	(d)	(d)	91,409	$0.89	86,362	2.95
1915					(d)	(d)	91,415	1.19	82,177	2.90
1916			220	10.46	(d)	(d)	135,212	1.56	127,341	4.81
1917			441	9.08	(d)	(d)	207,408	1.47	172,284	6.73
1918			220	12.73	(d)	(d)	127,164	1.48	235,542	6.32
1919			5,952	13.16	(d)	(d)	99,939	1.22	85,395	16.51
1920			220	14.55	3,327	$1.38	129,283	1.17	45,971	45.27
1921					2,884	.76	68,501	.98	47,501	(d)
1922	80,640	$0.72			2,430	1.08	131,590	1.09	54,448	(d)
1923	275,518	.57	220	18.18	1,537	1.33	183,816	.88	54,434	(d)
1924	356,345	.44	220	9.09	(d)	(d)	129,328	.60	22,615	(d)

[a] Exports.
[b] Converted into terms of United States money by using average yearly exchange, furnished by United States Treasury Department.
[c] In view of the fluctuations in exchange during the years under review no attempt has been made to convert the values into terms of United States money.
[d] Data not available.

IMPORTS AND EXPORTS

The following table, which is taken from the records of the Bureau of Foreign and Domestic Commerce, shows the imports of metallic cadmium only, as the quantity and value of cadmium imported as pigment are not recorded separately:

Cadmium imported for consumption in the United States, 1915–1924

Year	Pounds	Value	Year	Pounds	Value
1915	269	$284	1922	2,240	$2,434
1916–1920			1923	16	119
1921	101	216	1924	1,102	743

Statistics of the exports of cadmium are not separately kept by the Bureau of Foreign and Domestic Commerce, but it is known that a considerable quantity of domestic stick cadmium was exported during the World War and some in 1923 and 1924. Some cadmium-bearing residues have been exported at times.

The competition of Australian metallic cadmium in the European markets in 1923 brought the American price for cadmium down nearly to pre-war figures plus the duty of 15 cents a pound. In consequence, very little cadmium was imported.

PRICES AND VALUE

The price of metallic cadmium, as quoted by the Engineering and Mining Journal-Press, was $1.15 a pound through the first quarter of 1923, but this quotation declined by successive stages until at the end of the year it stood at 75 to 80 cents a pound. The average selling price of metallic cadmium as reported by producers in 1923

was 88 cents a pound, as compared with an average selling price of $1.09 in 1922.

The price quoted on cadmium sulphide at the beginning of 1923 was $1.50–$1.75 a pound. This quotation held until October, during which the lowest price of the year, $1.45–$1.60, prevailed. A sharp rise to $1.75–$2.50 about the first of November lasted until the end of the year. The average quoted price for cadmium sulphide in 1923 was $1.75 a pound, as compared with a quoted average of $1.60 in 1922. The average selling price of cadmium sulphide in 1923 is not available, but in 1922 it was about 70 per cent of the average quoted price.

In 1924 the price of metallic cadmium was quoted at 75 to 80 cents a pound through January and at 70 to 75 cents through February, March, and the first part of April, when it dropped to 60 cents. It remained at that figure through the rest of the year, with the exception of a short period of two weeks in the fall when it was quoted at 55 to 60 cents. The average selling price for the year was 60 cents a pound.

The price of cadmium sulphide was quoted at $1.75–$2.50 a pound at the beginning of 1924 and except for a slightly lower quotation in May remained at that figure until November. It then rose to $2–$2.50 and remained there through the rest of the year.

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QUICKSILVER

By Clyde P. Ross

STATISTICAL SUMMARY

Quicksilver produced in the United States in 1924

	Producing mines	Ore treated (short tons)	Quicksilver obtained		
			Weighted mean percentage tenor	Flasks of 75 pounds	Value
California	6	59,402	0.48	[a] 7,966	$547,185
Texas, Nevada, Oregon, and Idaho	6	10,789	[b] .59	[c] 2,095	143,905
Total, 1923	12	70,191	.50	10,061	691,090
	14	50,796	.59	7,937	521,302

[a] Includes 214 flasks obtained from clean-ups, etc., not considered in calculating percentage tenor.
[b] Takes into account a small amount left in condensers at one mine, not included in production.
[c] Includes 447 flasks obtained from an unknown quantity of ore, not considered in calculating percentage tenor.

Average price per flask: San Francisco, $68.69; New York, $69.51; London, £11 19s. 8d.
Imports entered for consumption in the United States, 987,719 pounds, or 13,170 flasks.
Exports from the United States, 15,581 pounds, or 208 flasks.

PRODUCTION

DOMESTIC PRODUCTION

The production of quicksilver in the United States in 1924 increased about 27 per cent from 1923, though the increase in the average price at San Francisco was only about 5 per cent. In general, there has been a steady recovery from the depression of 1921, although production is still well below that of pre-war years.

The number of producing mines in the United States decreased from 14 in 1923 to 12 in 1924. Two of these yielded over 2,000 flasks each, and one other more than 1,000 flasks. Only three others yielded more than 150 flasks. Two of the operators treated no new ore and obtained their production from clean-ups of reduction plants and from old dumps. The increase in total output resulted from marked increases at a few mines. If these exceptional gains were discounted the production would actually be less than in 1923. Apparently present prices are high enough to encourage the operators of the better mines, but not to induce much production from less favorably situated properties. Since the war the response to price changes has been somewhat more prompt than in previous years.

According to reports to the Geological Survey from individual mining companies or mine operators, the output of quicksilver in the United States in 1924 was 10,061 flasks of 75 pounds each, against

7,937 flasks in 1923 and 6,375 flasks in 1922. One company has adopted the practice of placing 76 pounds of quicksilver in its flasks, to accord with the European standard of 34.5 kilograms per flask. For use in this report the production of this mine has been recalculated on the basis of flasks of 75 pounds each.

At the average price for the year, $68.69 a flask, based on quotations for domestic quicksilver in San Francisco published weekly by the Engineering and Mining Journal-Press, the value of the output in 1924 was $691,090, an increase of $169,788 from 1923. The producers of 9,341 of the 10,061 flasks gave in their statistical reports the value of the product. On the supposition that this was in general the amount received from sales, it corresponds to an average selling price of $64.52 a flask, or $4.17 less than the average quotation at San Francisco.

Quicksilver produced in the United States, 1921–1924, by States

State	1921		1922		1923		1924	
	Flasks	Value	Flasks	Value	Flasks	Value	Flasks	Value
California	3,055	$144,868	3,405	$196,741	5,447	$357,759	7,966	$547,185
Idaho,[a] Nevada, Oregon, and Texas	3,284	155,727	[a] 2,970	[a] 171,607	2,490	163,543	2,095	143,905
	6,339	300,595	6,375	368,348	7,937	521,302	10,061	691,090

[a] No production from Idaho in 1922.

A table showing the quicksilver produced in the United States from 1850 to 1921 is given in Mineral Resources for 1921.

QUANTITY AND TENOR OF ORE MINED AND TREATED

In 1924 the yield from retorts in the United States is reported to have been 173 flasks of quicksilver, against 53 flasks in 1923. Part of this was not taken from the condensers and is not included in the figures of total production. The production from retorts in 1924 was obtained from 481 tons of ore, so that the average yield was 1.35 per cent, or 27 pounds to the ton of ore. The total quantity of quicksilver ore reported as treated in furnaces during the year was 69,710 tons, and this ore yielded 9,287 flasks of quicksilver—a rate of 0.50 per cent, or 10.0 pounds to the ton of ore, as compared with an average yield of furnace ore in 1923 of 0.57 per cent, or 11.4 pounds to the ton. In addition 214 flasks of quicksilver was derived from material obtained from clean-ups and from old dumps and treated in furnaces, and 447 flasks from an unreported quantity of ore.

METHODS OF PRODUCTION

The ores of quicksilver, unlike those of most metals that are won by smelting, are without exception in this country treated at the mines, and the liquid metal is shipped as a finished commercial product. Methods of treatment have been briefly described in the reports for 1917, 1918, and 1919.

WORLD'S PRODUCTION

In the accompanying table, compiled by W. I. Whiteside, of the United States Geological Survey, are given the best figures available for the world's production of quicksilver in 1920–1924. Official statistics have been used so far as possible. The foreign figures, generally published in metric tons, are calculated to flasks of 75 pounds net.

The production in 1924 is known only for Italy, Russia, and the United States. Italy decreased about 57 per cent and the United States increased about 27 per cent. It is reported, however, that Austria produced 5 metric tons of quicksilver ore in 1924. This is the first production reported from Austria since the end of the World War. Rumania had a reported production of 200 metric tons of quicksilver ore in 1923, and Yugoslavia is reported to have produced 10 metric tons of ore in 1920. The amount of quicksilver obtained from the ore of these three countries is not known.

The management of the Almaden mines in Spain was again changed early in 1924, and production is reported to have been very small for several months while the change was being effected. On February 14, 1925, it was announced that in future prices would not be published but would be the subject of contracts in each transaction.

World's production of quicksilver, 1920–1924

[1 metric ton=29.395 flasks]

Country [a]	1920		1921		1922		1923		1924	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
China	1,337	45.5	2,881	98.0	503	17.1	47	1.6	[b]	[b]
Czechoslovakia	1,958	66.6	1,678	57.1	185	6.3	1,499	51.0	[b]	[b]
Italy	41,182	1,401.0	31,482	1,071.0	45,298	1,541.0	48,666	1,655.6	48,237	1,641.0
Japan	79	2.7	173	5.9	35	1.2	[c]	[c]	[b]	[b]
Mexico	2,269	77.2	1,352	46.0	1,229	41.8	1,314	44.7	[b]	[b]
New Zealand	49	1.7	21	.7	21	.7	-------	-------	[b]	[b]
Russia	-------	-------	138	4.7	647	22.0	1,499	51.0	[d] 1,940	[d] 66.0
Spain	25,330	861.7	18,678	635.4	38,748	1,318.2	33,646	1,144.6	[b]	[b]
United States	13,392	455.6	6,339	215.6	6,375	216.9	7,937	270.0	10,061	342.3
	85,596	2,912.0	62,742	2,134.4	93,041	3,165.2	94,608	3,218.5	-------	-------

[a] In addition to the countries shown in the table Bolivia exported in 1921 72 kilograms (2 flasks). Information furnished on May 21, 1923, by the United States High Commissioner of Turkey places Turkey's average annual production at approximately 67 tons (1,969 flasks). These figures are not included in the above totals.

[b] Data not available.

[c] Only 4 kilograms reported.

[d] Figures represent output for year ended Sept. 30, 1924.

PRICES

The price of quicksilver remained fairly steady near $60 a flask from the first of the year until the middle of March, then rose to $79 early in May. It decreased to $71 in the first week in August, rose to $73 late in September, decreased to $68.50 in November, and rose again to $74 at the end of the year.

Average yearly prices of quicksilver in the United States and the United Kingdom, 1913–1924

[Per flask of 75 pounds]

Year	San Francisco [a] (domestic)	New York [b]	London [c]	Year	San Francisco [a] (domestic)	New York [b]	London [c]
			£ s. d.				£ s. d.
1913	$40.23	$39.54	7 9 2	1919	$90.29	$92.15	20 9 5½
1914	49.05	48.31	[d] 7 15 0	1920	79.66	81.12	20 14 9
1915	85.80	87.01	14 10 8	1921	47.42	45.46	11 3 5
1916	125.89	125.49	17 2 10	1922	57.78	58.95	11 11 6
1917	105.32	106.30	22 4 3	1923	65.68	66.70	10 4 9
1918	117.50	123.47	[e]	1924	68.69	69.51	11 19 8

[a] Min. and Sci. Press, San Francisco. } Eng. and Min. Jour.–Press in 1922–1924.
[b] Eng. and Min. Jour., New York. }
[c] Min. Jour. (London).
[d] Metal exchange closed about three months after outbreak of war. Average based on 37 weeks only.
[e] Quoted as "nominal" only.

Although San Francisco is commonly referred to as the "primary market" for quicksilver in the United States, from the fact that the greater part of this metal produced in the country comes from the Pacific coast and goes through the hands of San Francisco firms, yet it should be noted that that city is not a market in the same sense as New York. Most of the quicksilver that passes nominally through San Francisco is handled on commission and is sold in New York, which consequently is the great distributing point of quicksilver to the actual customers. At the present low ebb in production in California the supremacy of that State as a producer of quicksilver is not so pronounced as formerly.

Prices of domestic quicksilver at San Francisco, 1922–1924, by months

[Per flask of 75 pounds]

Month	1922	1923	1924	Month	1922	1923	1924
January	$48.50	$71.05	$59.56	July	$54.55	$66.25	$71.70
February	47.65	69.20	59.53	August	56.15	65.01	71.47
March	48.65	69.53	61.27	September	63.95	61.87	71.54
April	50.85	70.26	71.33	October	70.45	61.00	71.64
May	54.40	67.16	72.65	November	70.45	61.34	72.43
June	54.75	66.80	71.91	December	70.75	59.95	70.84

IMPORTS AND EXPORTS[1]

The import duty on quicksilver under the Underwood tariff bill, enacted in 1913 and in force up to September 21, 1922, was 10 per cent ad valorem. The tariff act of 1922 placed a duty on imported quicksilver equivalent to $18.75 a flask.

In the following tables are given total imports of quicksilver for domestic consumption, total annual exports, and annual imports and exports by countries. The figures in pounds for annual imports and exports have been calculated to the approximate equivalent in metric tons and in flasks.

[1] Compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Quicksilver imported for consumption in the United States, 1919–1924

Year	Pounds	Metric tons	Flasks	Value
1919	797, 613	361. 79	10, 635	$791, 226
1920	1, 062, 647	482. 01	14, 169	971, 510
1921	795, 078	360. 64	10, 601	457, 993
1922	1, 269, 004	575. 61	16, 920	757, 842
1923	1. 355, 499	614. 84	18, 073	816, 043
1924	987, 719	448. 02	13, 170	566, 820

Quicksilver imported into the United States, 1923–24, by countries

[General imports]

Country	1923		1924	
	Pounds	Value	Pounds	Value
Argentina	2, 700	$1, 301		
Belgium			3, 000	$1, 937
Chile	805	650		
Cuba			2, 475	1, 090
England	199, 780	125, 354	138, 400	87, 203
Germany	6, 273	4, 525	10, 605	5, 852
Honduras	175	88		
Hongkong			5	4
Italy	472, 421	273, 401	583, 380	336, 025
Mexico	85, 868	46, 749	87, 096	43, 465
Spain	800, 529	448, 963	80, 717	45, 294
	1, 568, 551	901, 031	905, 678	520, 870

The imports are reported as (1) imports for consumption, which include quicksilver entered for immediate consumption and that withdrawn from bonded warehouses for consumption, and (2) general imports. In 1924 the imports for consumption as reported exceeded the actual receipts from abroad during the year, because more quicksilver was withdrawn from bonded warehouses during the year than was put in. At the end of 1923 there remained in such warehouses 125,800 pounds, or 1,677 flasks, valued at $65,807, whereas on December 31, 1924, there were only 8,676 pounds, or 116 flasks, valued at $6,049. After decreases in January and February the amount in bonded warehouses rose to 124,714 pounds in March, then decreased gradually to 3,750 pounds in September, jumped to 35,476 pounds in the next month, then decreased to the end of the year.

Quicksilver exported from the United States, 1919–1924

Year	Pounds	Metric tons	Flasks	Value
1919	683, 004	309. 80	9, 107	$817, 328
1920	116, 493	52. 84	1, 553	129, 993
1921	29, 501	13. 38	393	18, 869
1922	21, 834	9. 90	291	15, 910
1923	23, 827	10. 81	318	25, 195
1924	15, 581	7. 07	208	14, 333

Quicksilver exported from the United States, 1923–24, by countries

	1923		1924	
	Pounds	Value	Pounds	Value
North America:				
British Honduras	4	$6	50	$50
Canada	13,380	15,118	2,421	2,000
Costa Rica	305	289	570	531
Guatemala			450	360
Honduras	121	148	87	96
Mexico	616	653	1,431	1,788
Nicaragua	376	434	675	660
Panama	421	344	2	2
Salvador	375	388	600	622
West Indies:				
British	12	17		
Cuba	476	451	630	717
Dominican Republic	110	110	1,126	787
Dutch			25	29
Haiti	175	192	155	159
Virgin Islands of the United States	15	15	30	13
South America:				
Argentina	75	91		
Brazil	1,500	1,378	97	104
Chile	175	209		
Colombia	2,031	1,811	3,449	2,965
Ecuador	10	13	60	70
Guiana, British	225	240		
Peru	812	814	690	799
Venezuela	786	691	397	374
Europe:				
England	20	29	50	44
Sweden	55	49		
Asia:				
China			30	28
Chosen	900	852		
East Indies, Dutch	75	75		
Japan	77	108		
Philippine Islands	620	560	1,676	1,625
Oceania: New Zealand	80	110	880	510
	23,827	25,195	15,581	14,333

USES OF QUICKSILVER

Most of the uses of quicksilver, which are exceedingly varied, have been rather fully described in previous reports. Use in the Emmet mercury boiler, described in the report for 1923, is still largely a matter for the future. The public has shown great interest in experimental conversion of quicksilver into gold by atomic disintegration, but at present this is of theoretical scientific interest rather than of practical value. A process is reported to have been developed for making cast-iron pipe centrifugally, using quicksilver in the hollow mold. Quicksilver vapor has been advocated as an industrial heating medium. It is reported that a commercial plant employing it was successfully operated in 1915 and that there have been altogether 12 such installations, aggregating 650 boiler horsepower. A mercury contactor has recently been developed which may be used in place of any electric switch. It is said to be safe, to be positive in its action, and to require no adjusting or cleaning.

QUICKSILVER MINING INDUSTRY, BY STATES

Alaska.—A small amount of quicksilver was produced in Alaska in 1924, and it is reported that promising deposits exist, although the development so far is small.

Arizona.—Prospecting and development were carried on in the Mazatzal Mountains and in the Copper Basin district southwest of Prescott, Ariz.

California.—The production of quicksilver in California increased about 46 per cent over that of 1923. There were six producers in 1924, as against nine in 1923, and one of these obtained the metal from material from clean-ups and from old dumps. At a few properties development work only was done. The total production of the State was 7,966 flasks of 75 pounds each, valued at $547,185. The output in 1923 was 5,447 flasks, valued at $357,759. California produced 79 per cent of the total quicksilver output of the country in 1924, as compared with 69 per cent in 1923.

The New Idria mine, in San Benito County, continued to be a large producer. No activity except assessment work is reported from Kings County. In Lake County development work is reported at two properties, and some quicksilver was obtained from material already on hand. The production of this county should increase in 1925. In Monterey County the production in 1924 was small, but it is expected to increase in 1925, after the new furnace at the Patriquin mine is put into operation. The Cloverdale mine, in Sonoma County, was one of the larger producers in the State. In San Luis Obispo County a small amount of quicksilver was produced, and development work was carried on. The New Almaden mine, in Santa Clara County, continued to be one of the largest producers.

Idaho.—Quicksilver is known in a number of localities in Idaho, but little development work has been done. A small production was obtained in 1924 at the United Mercury Mines Co.'s property, in Valley County. A retort and condenser plant of a new type is being installed at this property.

Nevada.—The production of quicksilver in Nevada increased in 1924. It is known that three properties were productive, and some quicksilver may have been obtained from others.

Oregon.—As usual, the only quicksilver produced in Oregon in 1924 was a small amount in the Meadows district, Jackson County, but some activity is reported in the southeastern part of the State.

Texas.—The Chisos mine, in the Terlingua district, Brewster County, Tex., continued to be a large producer but is still hampered by trouble with water. Development work was carried on at other properties in the State, and the production in the future should increase.

BAUXITE AND ALUMINUM

By James M. Hill [1]

BAUXITE

DOMESTIC PRODUCTION, IMPORTS, AND EXPORTS

The bauxite industry of the United States was less productive in 1924 than in 1923, owing to the increased imports and lower demand for bauxite by all consuming industries. The domestic production of bauxite decreased 34 per cent, but imports increased 70 per cent. In the Arkansas field the decrease was 34 per cent and in the eastern field 31 per cent.

Bauxite produced in the United States, 1920–1924

Year	Georgia, Alabama, and Tennessee		Arkansas		Total	
	Long tons	Value[a]	Long tons	Value[a]	Long tons	Value[a]
1920	40,029	$349,453	481,279	$2,897,892	521,308	$3,247,345
1921	14,700	134,400	124,850	755,400	139,550	889,800
1922	42,810	329,440	266,790	1,682,890	309,600	2,012,330
1923	28,810	176,030	493,880	2,980,580	522,690	3,156,610
1924	19,940	156,990	327,630	1,981,000	347,570	2,137,990

[a] Value f. o. b. mines.

Bauxite imported into and bauxite and bauxite concentrates exported from the United States, 1920–1924

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1920	42,895	$251,284	22,257	$1,843,596
1921	27,587	164,589	5,942	488,785
1922	23,656	93,805	19,617	961,208
1923	119,020	593,882	78,560	3,380,486
1924	201,974	909,493	77,065	3,979,832

Bauxite was imported from British Guiana during 1924 at the rate of 11,400 tons a month. Most of it was entered at Gulf ports and used in the aluminum industry. A few cargoes of South American bauxite were shipped to north Atlantic ports and consumed by the chemical industries. Bauxite from British and Dutch Guiana

[1] The figures for imports and exports in this report have been compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

formed a considerable part of the supplies of the United States during 1924. Owing to the large size, high quality, and ease of exploitation of the deposits in these countries their bauxite has replaced the domestic bauxite except that from deposits where the conditions for exploitation are exceptionally favorable.

A small quantity of alumina obtained as a by-product in the treatment of alunite for its potash content at Marysvale, Utah, was used for refractories.

Domestic bauxite was reported as sold to five consuming industries in 1924, as shown in the following table. The sales to the aluminum industry decreased 41 per cent, those to the artificial abrasive industry 9 per cent, and those to the manufacturers of aluminum salts 20 per cent.

Domestic bauxite sold by producers to industries in the United States, 1920–1924, in long tons

Industry	1920	1921	1922	1923	1924
Aluminum	383,154	91,700	211,560	380,520	225,780
Chemical	85,878	41,000	78,540	68,870	54,870
Abrasive [a]	[b] 52,276	6,850	19,270	72,830	66,400
Refractory	[b]	----------	230	470	440
Alumina cement	----------	----------	----------	----------	80

[a] Includes alumina used for refractories.
[b] Small quantity sold to makers of refractories probably included under "Abrasive."

For the last few years it has been impossible to give separate statistics showing the output of either artificial aluminum abrasives or refractories. Some measure of the combined output of these materials made from bauxite may be had from the quantity of bauxite sold to manufacturers, as indicated in the table above. Figures for aluminous abrasives heretofore reported in the chapters on bauxite and aluminum and abrasives in Mineral Resources have included annually increasing quantities of aluminum oxide used as refractory material.

Value of aluminum and aluminum salts made from bauxite, 1920–1924

Year	New aluminum	Aluminum salts
1920	$41,375,000	$9,968,200
1921	10,906,000	7,547,200
1922	13,622,000	8,813,000
1923	28,305,000	8,987,400
1924	37,607,000	9,301,400

MARKET AND PRICES

Bauxite finds its market east of Mississippi River and is sold largely to the manufacturers of aluminum, abrasives, commercial chemicals, and refractories. In 1924 the market for the manufacture of the alumina cements was largely met by imported bauxite, but a few tons of domestic bauxite was sold for this use. High-alumina clays are now being sold according to their alumina content, and three grades containing 55, 65, and 70 per cent of alumina (Al_2O_3)

are regularly handled. In the last few years some of the makers of refractories and aluminum chemicals have been using clay as a crude material in place of bauxite.

The largest consumers of bauxite in the United States are also producers, and there is only a small market for what might be called "outside bauxite." Consumers who do not own deposits contract for their supplies for considerable periods, apparently to assure an adequate supply of bauxite of the grade desired. The price of bauxite at mines or shipping points in 1924, as reported by independent producers, ranged from $6.60 to $6.71 a ton; the average price reported by all producers for the year was $6.15 a ton f. o. b. mines. Consumers, on the other hand, report prices that average $12.97 a ton f. o. b. plants, approximately the same as in 1923.

The price of bauxite is now regularly quoted in the Engineering and Mining Journal-Press. Crushed bauxite was quoted at $5.50 to $8.75 a ton throughout the year. Dried and pulverized bauxite was quoted at $12 to $14, and calcined bauxite at $19 to $20 a ton f. o. b. shipping point. Foreign bauxite was offered at $5 to $7.50 c. i. f. American ports.

Under the tariff act of 1922 crude bauxite is dutiable at the rate of $1 a ton, and alumina hydrate or refined bauxite at half a cent a pound. (See paragraph 6, schedule 1, and paragraph 207, schedule 2.)

WORLD'S PRODUCTION

The following table was compiled by Miss W. I. Whiteside, of the United States Geological Survey, from official sources so far as possible:

World's production of bauxite, 1913 and 1918–1923, by countries, in metric tons

Country	1913	1918	1919	1920	1921	1922	1923
Austria:							
Dalmatia	[a]	[b] 94,500	[c]	[c]	[c]	[c]	[c]
Istria	[a]	[b] 70,100	[a]	[d]	[d]	[d]	[d]
Lower Austria	[e]	[e]	[e]	362	2,638	4,095	2,734
France	309,294	[a]	159,103	266,716	95,318	236,141	314,330
Guiana:							
British		4,266	1,999	31,883	[f]	[f]	101,957
Dutch						18,805	15,839
Germany	[g]	14,353	9,393	13,420	10,122	[b] 20,000	[b] 16,000
Hungary	1,792	[a]	[a]	[a]	[a]	[a]	[a]
India, British	1,203	1,211	1,709	6,401	6,759	4,998	6,652
Italy	6,952	7,800	2,972	[d] 13,139	[d] 49,120	[d] 66,646	[d] 98,055
Rumania	[h]	[h]	[h]	[h]	[h]	3,737	4,162
Spain		460	1,780	540	184		
United Kingdom	6,152	9,743	9,369	11,197	2,305	5,953	3,504
United States	213,615	615,443	382,610	529,675	141,790	314,569	531,079
Yugoslavia	[i]	[i]	[a]	27,860	10,021	31,290	32,631

[a] Data not available.
[b] Unofficial figures.
[c] Included under Yugoslavia.
[d] Istria included under Italy.
[e] No record of any production prior to 1920, when one mine was operated.
[f] Early in 1921 operations at the bauxite mines were discontinued, and the mines remained closed until late in 1922. Shipments of 20,010 tons were made from stocks in 1921. No shipments were made in 1922.
[g] No separate figures of bauxite production prior to 1917 are available, the figures being included with those of tin, cobalt, nickel, vitriol, and bismuth.
[h] The bauxite deposits of the Bihar Mountains in Rumania were not exploited until the war, when they were owned by Hungary.
[i] Prior to 1919 production included with Austria and Hungary.

BAUXITE DEPOSITS

Nelson,[2] in a discussion of the bauxite deposits in Tennessee and Georgia, suggests that the origin of these deposits is due to precipitation of alumina in swamps on a peneplain, now 850 feet above sea level. He believes that the alumina was derived from bentonite by leaching of waters carrying sulphuric acid, and that precipitation took place in the swamp areas owing to the presence of tannic acid. Burchard [3] ascribes a similar origin to the bauxite deposits in northeastern Mississippi.

Alabama.—No bauxite was produced in Alabama in 1924. It is reported that there are a number of scattered deposits of bauxite of chemical grade in the Eufaula district, the area between Fort Gaines and Clayton, in Henry and Barbour counties, some of which will doubtless be worked in competition with South American bauxite, as well as with that from the more easily accessible Georgia fields.

Arkansas.—Five companies in Arkansas produced 327,630 long tons of bauxite in 1924, a decrease of 34 per cent as compared with the production of 1923. The deposits in Saline County contributed 93 per cent of the output. The producing companies, named in the order of output, are American Bauxite Co., Republic Mining & Manufacturing Co., Southern Bauxite Co., Globe Bauxite Co., and Superior Bauxite Co.

Georgia.—Three companies produced bauxite from three counties in Georgia in 1924. The total output was 16,140 long tons, a decrease of 28 per cent from the output in 1923. The largest producer was the Republic Mining & Manufacturing Co., which operated mines near Vans Valley, Floyd County, and Irwinton, Wilkinson County. The Kalbfleisch Corporation operated mines in Macon County near Andersonville. The Ideal Bauxite Mining Co., at Ellaville, Macon County, was the third.

Mississippi.—No commercial shipments of bauxite have yet been made from the deposits in northeastern Mississippi, which were discovered by J. W. Adams in 1921, but several tons has been sent to the Fixed Nitrogen Research Laboratories of the Department of Agriculture in Washington, D. C., for experimental use. Reports on these deposits have been made by P. F. Morse [4] and E. F. Burchard.[5] The commercial possibilities of these deposits, according to Burchard, may be summarized as follows:

> Estimates of the quantity of bauxite on the lands owned in fee and leased by the Mississippi Bauxite Co., made by W. C. and P. F. Morse, show a grand total of nearly 1,500,000 long tons, of which more than two-fifths carries 30 to 35 per cent of alumina (Al_2O_3), nearly as much more carries between 35 and 45 per cent, less than one-fifth carries between 45 and 55 per cent, and the remainder, which is less than 25,000 tons, is distributed between grades carrying less than 30 per cent and those containing between 55 and 60 per cent. There are other deposits of bauxite in northeastern Mississippi that have not been included in these estimates, and further studies are likely to add to the known reserves. Although the bulk of this bauxite is of low to medium grade, there are many uses for which such ore should be of value. In addition to the current metallurgical, chemical, refractory, and abrasive uses for bauxite, a new use in the manufacture of alumina cement, a quick-setting hydraulic cement now used to a large extent in France

[2] Nelson, W. A., Appalachian bauxite deposits: Geol. Soc. America Bull., vol. 34, pp. 525–540, 1923.
[3] Burchard, E. F., Bauxite associated with siderite: Geol. Soc. America Bull., vol. 35, pp. 437–448, 1924; Bauxite in northeastern Mississippi: U. S. Geol. Survey Bull. 750, pp. 115–116, 1925.
[4] Morse, P. F., The bauxite deposits of Mississippi: Mississippi Geol. Survey Bull. 19, 208 pp., 1923.
[5] Burchard, E. F., Bauxite in northeastern Mississippi: U. S. Geol. Survey Bull. 750, pp. 101–148, 1925.

and soon to be manufactured in the United States, seems an interesting possibility.

Most of these deposits of bauxite are from 5 to 10 miles or more from the Gulf, Mobile & Northern and Mobile & Ohio railroads, and the intervening country is underlain by a tough clay, over which unsurfaced roads are impassable in wet weather and hard and rutty in dry weather. A beginning has been made in the use of gravel and concrete for road building in this part of the State, and a portion of the road from Pontotoc to Tocopola, which will tap one of the major groups of bauxite deposits, has been paved with concrete. Mining of the deposits will necessarily have to await the preparation of roads suitable for motor-truck haulage, but even though production is temporarily retarded here, the rapid depletion of ore in other domestic fields, together with the proximity of large water power at Muscle Shoals, in the adjacent portion of Alabama, encourages the belief that the bauxite of northeastern Mississippi must be considered one of the natural resources that will contribute to the utilization of the Tennessee River power.

Tennessee.—The bauxite properties in the vicinity of Chattanooga, Tenn., were not particularly active in 1924. The Perry mine was operated by the Kalbfleisch Corporation, and a near-by deposit by the M. K. & T. Co., of Chattanooga.

Utah.—Somewhat over 600 tons of by-product alumina from Marysvale, Utah, was used for the manufacture of high-grade aluminous refractories in 1924. Experiments have been carried further looking to the manufacture of aluminum sulphate and potash alum from Utah alunite.

BAUXITE ABRASIVES

During 1924 makers of artificial aluminous abrasives and aluminum oxide for other uses purchased 66,400 tons of bauxite, as compared with 72,830 tons in 1923. Detailed statistics of production of aluminous artificial abrasives for recent years are not available for publication, but they are combined with the figures of output of silicon carbide abrasives in the chapter on abrasive materials.

The Norton Co., of Worcester, Mass., makes various refractory products of alumina fused in the electric furnace and apparently uses bauxite for some products and alumina for others.

The Vitrefrax Co., of Los Angeles, Calif., has recently put on the market several superrefractories, among which is durox, a crystalline sillimanite made in the electric furnace, and argon, a fire brick made from a highly aluminous fire clay.

BAUXITE CEMENT

During 1924 makers of alumina cements used 80 tons of domestic bauxite and an unknown quantity of imported (mostly Dalmatian) bauxite. It would seem that the local cement industry must carefully study its requirements for bauxite in relation to world reserves, as the domestic supply of bauxite has already a wide and growing market.

ALUMINUM

DOMESTIC PRODUCTION, IMPORTS, AND EXPORTS

The value of the new aluminum produced in the United States in 1924 was 33 per cent greater than in 1923, and the value of the secondary aluminum increased 35 per cent.

According to statistics collected by J. P. Dunlop, of the United States Geological Survey, secondary aluminum was recovered to the amount of 10,350 short tons as metal and 16,650 short tons as the aluminum content of casting alloys. The total recovery was 27,000 short tons.

Value of aluminum produced in the United States, imported, and exported, 1920–1924

Year	Domestic production		Imports [b]	Exports [c]
	Primary metal	Secondary metal [a]		
1920	$41,375,000	$9,489,100	$13,077,022	$5,630,781
1921	10,906,000	3,775,400	8,889,791	3,108,857
1922	13,622,000	6,085,900	9,695,012	2,836,116
1923	28,305,000	10,824,600	8,742,563	3,571,539
1924	37,607,000	14,596,200	7,145,036	4,172,390

[a] Value of secondary aluminum based on average price at New York as given by American Metal Market.
[b] Imports for consumption include aluminum in crude form, scrap, bars, strips, rods, plates, sheets, and all manufactures of aluminum.
[c] Exports include ingots, metal and alloy, plates and sheets, and all manufactures of aluminum.

The following tables show the forms in which most of our aluminum is imported and exported. In 1924 the bulk of the imported aluminum was in crude and semicrude form.

Aluminum imported for consumption in the United States, 1923–24

Class	1923		1924	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Crude form, scrap, alloy, etc	41,334,837	$8,028,942	30,997,371	$6,640,192
Plates, sheets, bars, strips, rods, coils, and blanks	299,011	96,383	203,153	62,189
Circles, disks, rectangles, and squares	842,941	192,391	609,417	157,404
	42,476,789	8,316,816	31,809,941	6,859,785
Manufactures:				
Tubes, moldings, castings, and other shapes	86	214	85	70
Leaf (5½ by 5½ inches)	[a]	26,311	[a]	25,420
Powder, powdered foil	131,053	54,884	88,113	38,230
Foil less than 0.006 inch thick	15,756	14,666	25,527	18,864
Table, kitchen, and hospital utensils and other similar hollow ware	682,431	291,756	335,785	152,675
All other manufactures	58,295	37,916	74,135	49,992
		425,747		285,251
Grand total		8,742,563		7,145,036

[a] 1923, 2,059,051,200 leaves; 1924, 1,959,266,300 leaves; equivalent in pounds not recorded.

About 48 per cent by weight of the exports in 1924 consisted of crude and semicrude forms, as compared with 51 per cent in 1923.

Domestic aluminum exported from the United States, 1923–24

Class	1923		1924	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Ingots, scrap, and alloys	1,169,753	$236,878	3,356,786	$703,996
Plates, sheets, bars, strips, and rods	4,369,918	1,280,684	2,986,726	928,319
	5,539,671	1,517,562	6,343,512	1,632,315
Manufactures:				
Tubes, moldings, castings, and other shapes	442,370	189,477	3,574,427	1,098,578
Table, kitchen, and hospital utensils	1,175,659	697,372	1,026,593	570,842
Other manufactures of aluminum	3,784,005	1,167,128	2,182,220	870,655
	5,402,034	2,053,977	6,783,240	2,540,075
Grand total	10,941,705	3,571,539	13,126,752	4,172,390

MARKET AND PRICES

Quotations on virgin aluminum, as given by the Engineering and Mining Journal-Press, began the year at 27 cents a pound for the 99 per cent grade, reached 28 cents a pound January 12, and averaged 28 cents throughout the year. The 98 per cent domestic grade was 1 cent a pound cheaper. Foreign and secondary aluminum was sold at 1 to 2 cents a pound below the domestic figure for similar grades.

ALUMINUM INDUSTRY [6]

The demand for aluminum in 1924 was somewhat less than in 1923, owing to the curtailment of output and the greater use of pressed-steel parts by the automobile industry.

The new silicon-aluminum alloys [7] containing as much as 15 per cent of silicon are coming into more general use, particularly for casting, and nickel-silicon-aluminum and copper-silicon-aluminum alloys are being used for die casting.

Aluminum powder is finding a much larger market in the paint trade and is proving a very good protective pigment for structural steel.[8]

The market for aluminum cables for transmitting high-tension electric current has been greater.

Canadian aluminum plants were not quite so productive in 1924 as in 1923, as shown by their imports of alumina from the United States.

French aluminum makers are reported to have been unable to supply the domestic demand [9] and to be apprehensive as to future supplies of bauxite because of the increased demand by makers of alumina cements. France has become an importer of aluminum.

In Germany the Lautawerk, Erftwerk, and Bitterfeld aluminum plants have been producing, and the Innwerke plant was placed in operation late in 1924. The annual consumption of aluminum in Germany is estimated at about 12,000 tons but is expanding, though imports are decreasing, owing to larger home production.

The British Aluminum Co. operated the Kinlochleven and Foyers plants in Scotland and two plants in Norway. Bonds for the new

[6] See Mineral Industry for details covering aluminum industry in 1924.
[7] Edwards, J. D., and Archer, R. S., The new aluminum-silicon alloys: Chem. and Met. Eng., vol. 31, pp. 504–508, 1925.
[8] Walker, P. H., and Hickson, E. F., Some observations on aluminum paints: Chem. and Met. Eng., vol. 31, pp. 693–696, 1924.
[9] Jour. du four électrique, 34th year, various items, particularly pp. 210–211.

hydroelectric power plant at Lochaber were floated, assuring a considerable increase in capacity.

In Italy the Società italiana di elettrochimica continued production at about the same rate as in 1923.

In Norway aluminum was produced on a much larger scale than in 1923. Three plants at Arendal, Tyssedal, and Eydhaven operated by Det Norsk Nitride are controlled by L'Aluminum française. Det Norsk Nitride increased its capital stock from 5,000,000 to 15,000,000 kroner. The two plants at Stangfjord and Vigelands were operated by the British Aluminum Co., and the Aluminum Co. of America operated its plant at Hoyangaldene, where additional equipment is being installed. The output of the Hoyangaldene plant is largely sent to the United States in crude form.

In Switzerland production was well maintained by the Aluminum Industrie Aktien Gesellschaft, though some difficulty in procuring necessary raw materials was felt. The company is planning to increase its available power at Chippis. Apparently the situation was satisfactory, for the dividend rate was 12 per cent in 1924, as compared with 9 per cent in 1923.

A paper by Hubble [10] gives much information on the marketing problems of the producers and consumers of aluminum.

A complete treatise on aluminum,[11] which covers the ground from prospecting for bauxite to the fabrication of complicated parts made from aluminum or its alloys, has just been published.

ALUMINUM SALTS [12]

Manufacturers of aluminum salts report a consumption during 1924 of 106,150 long tons of bauxite, having an average value of $13 a ton at the plants, and an unrecorded quantity of high-alumina clay, as compared with 106,900 tons of bauxite and an unrecorded though large quantity of high-alumina clay in 1923. These figures do not include the bauxite made into alumina as a preliminary step in the manufacture of aluminum.

Aluminum salts produced in the United States, 1923–24

Salt	1923				1924			
	Number of producers reporting	Short tons	Value		Number of producers reporting	Short tons	Value	
			Total	Average			Total	Average
Alum:								
Ammonia	5	4,766	$327,017	$69	5	4,920	$333,770	$68
Sodium	(a)	(a)	(a)	(a)	4	13,920	765,740	55
Alumina hydrate	(a)	(a)	(a)	(a)	3	5,480	408,160	74
Aluminum chloride	4	5,362	654,580	122	3	5,510	724,430	131
Aluminum sulphate:								
Commercial—								
General	15	246,095	6,354,315	26	19	250,630	6,274,850	25
Municipal	4	4,303	94,048	------	6	5,690	89,160	------
Iron-free	5	16,007	676,680	42	7	15,570	673,470	43
Other aluminum salts	9	13,371	880,781	------	3	470	31,830	------
	----	289,904	8,987,421	------	----	302,190	9,301,410	------

[a] Included under "Other aluminum salts."

[10] Hubble, A. H., Marketing aluminum: Eng. and Min. Jour.-Press, vol. 118, pp. 851–852, 1925; The marketing of metals and minerals, McGraw Hill Co., 1925.

[11] Anderson, R. J., Metallurgy of aluminum, New York, H. C. Baird & Co., 1925.

[12] For details concerning developments in manufacture see U. S. Bureau of Mines reports and Mineral Industry.

Aluminum salts produced in the United States, imported, and exported, 1920–1924

Year	Domestic production		Imports		Exports [a]	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	258,009	$9,968,174	1,340	$69,896	(a)	(a)
1921	184,813	7,547,184	1,009	45,963	(a)	(a)
1922	281,480	8,812,987	2,889	116,971	13,225	$388,447
1923	289,904	8,987,421	2,318	120,663	17,805	505,732
1924	302,190	9,301,410	2,523	113,075	16,012	407,749

[a] Exports not separately shown prior to 1922. Figures for 1922 to 1924 represent aluminum sulphate only.

ALUMINOUS REFRACTORIES

High-alumina refractories are finding a wider market. That this industry is expanding is shown by the growing demand for high-alumina clays and other aluminous minerals by ceramists all over the country. In 1924 the makers of refractory brick took 440 tons of bauxite and 9,252 tons of high-alumina (diaspore) clay. Andalusite, kyanite, and sillimanite, the newly applied aluminous raw materials, were shipped from deposits in California in increasing amounts during 1924.

TIN

By Bertrand Leroy Johnson

PRODUCTION AND DEVELOPMENT

Tin mining in the United States in 1924 was carried on only in Alaska. The small output of tin-bearing concentrate (11.21 short tons) was obtained from the Hot Springs district of the Tanana region, where it was recovered incidentally to gold mining, and from the Port Clarence district on Seward Peninsula. The recoverable content of the metallic tin in the concentrate produced was about 7 short tons.[1]

Tin mined in the United States (including Alaska), 1917–1924, in short tons

[Metallic tin obtainable from concentrates produced in tin mining]

1917	110	1920	22	1923	1. 9
1918	69	1921	4	1924	7
1919	56	1922	1. 4		

SMELTING INDUSTRY

Only one tin-smelting plant in the United States, that of the American Smelting & Refining Co., at Perth Amboy, N. J., was in operation in 1924, and it produced but 486 short tons of metallic tin.[2]

Smelter output of metallic tin in the United States, 1917–1924, in short tons

1917	6, 065	1920	17, 652	1923	7, 466
1918	10, 284	1921	11, 542	1924	486
1919	12, 236	1922	9, 108		

IMPORTS AND EXPORTS[3]

Tin concentrate imported into the United States, 1917–1924

[General imports]

Year	Short tons	Value	Year	Short tons	Value
1917	9, 054	$4, 743, 099	1921	15, 340	$5, 672, 861
1918	18, 394	11, 444, 401	1922	13, 804	5, 504, 434
1919	19, 196	11, 871, 948	1923	3, 015	2, 169, 055
1920	34, 148	18, 795, 162	1924	[a] 174	71, 094

[a] Recorded as tin content.

[1] Data regarding the Alaska tin-mining industry were obtained from the Alaskan branch of the U. S. Geological Survey.

[2] American Smelting & Refining Co. Twenty-sixth Ann. Rept., for 1924, p. 8.

[3] Statistics of imports and exports compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the U. S. Geological Survey.

Metallic tin imported for consumption in the United States, 1917–1924

Year	Short tons	Value	Year	Short tons	Value
1917	72, 166	$63, 860, 340	1921	27, 101	$16, 645, 719
1918	71, 254	93, 144, 218	1922	67, 416	40, 797, 986
1919	44, 849	50, 890, 019	1923	77, 206	61, 092, 354
1920	62, 795	73, 440, 872	1924	72, 866	68, 953, 193

The details of the general imports of metallic tin for 1924 are given in the following table:

Metallic tin, as bars, pigs, blocks, grains, and granulated, imported into the United States in 1924

[General imports]

Country	Short tons	Value	Country	Short tons	Value
Australia	661	$630, 248	Japan	28	$29, 476
Canada	35	30, 405	Java and Madura	1, 134	1, 108, 660
China	73	67, 383	Netherlands	2, 825	2, 922, 226
England	13, 939	13, 244, 332	Straits Settlements	50, 938	47, 844, 455
Germany	716	670, 395			
Hongkong	2, 349	2, 241, 051		72, 866	68, 953, 193
Ireland	168	164, 562			

Metallic tin exported from the United States, 1920–1924, in short tons

Year	Domestic [a]	Foreign [b]	Year	Domestic [a]	Foreign [b]
1920	706	333	1923	840	331
1921	1, 154	406	1924	469	605
1922	901	329			

[a] Imported as ore and exported as pigs, bars, etc.
[b] Imported as pigs, bars, etc., and exported as such.

CONSUMPTION

The quantity of new (primary) tin made available for consumption in the United States during any year may be estimated by adding the general imports of metallic tin to the quantity of tin produced in the United States and subtracting from the result the sum of the domestic and foreign exports of metallic tin.

New tin made available for consumption in the United States, 1920–1924, in short tons

1920	79, 632	1923	83, 501
1921	37, 083	1924	72, 278
1922	75, 294		

The quantity of this new tin actually consumed in the United States during a given year is not susceptible of accurate determination, without a knowledge of the stocks in hand.

PRICES

The average price of Straits tin in New York in 1924 was 50.20 cents a pound, as compared with 42.71 cents in 1923.[4] The course of the market during the year is shown in the following table:

Average monthly prices, in cents per pound, of Straits tin in New York in 1924 [4]

January	48. 73	May	44. 17	September	49. 13
February	53. 43	June	42. 72	October	50. 56
March	55. 01	July	46. 25	November	54. 24
April	50. 02	August	51. 93	December	56. 21

The average price for the year in London was £248 17s. 4d. a ton of 2,240 pounds. The lowest price was £200¾, and the highest price was £298¼.[5]

[4] Metal Statistics, 1925, p. 333.
[5] Idem, p. 339

ARSENIC

By V. C. Heikes and G. F. Loughlin [1]

PRODUCTION

The output of refined and crude white arsenic (arsenious oxide, As_2O_3) in the United States in 1924, according to producers reporting, exceeded previous records and amounted to 20,177 short tons, of which 5,724 tons remained in stock. The total sales amounted to 14,453 tons, valued at $2,655,015, or an average of 9.2 cents a pound. The sales of crude arsenic, 92 to 96 per cent pure, amounted to 2,183 tons, at an average of 6 cents a pound. Most of the crude product was converted into weed killer at points of production, and some of the crude arsenic was sold in small lots to farmers for killing grasshoppers. Manufacturers of plate glass continued to find certain makes of crude arsenic of value to the glass industry. The sales of white or refined arsenic, 99 per cent or more pure, amounted to 12,270 tons, valued at $2,392,988, or 9.75 cents a pound. Small sales of red arsenic of domestic origin were reported from the stock made in 1922 at Index, Wash., but no metallic or elemental arsenic is known to have been produced in 1924 in the United States. Arsenic produced from all sources in the United States since the first output made at Everett, Wash., in 1901 is given in the following table:

Crude and refined white arsenic produced in the United States and imported, 1901–1924

Year	Sales of domestic product				Imports for consumption		
	Short tons		Value		Short tons	Value	
	Refined	Crude	Total	Average (cents per pound)		Total	Average (cents per pound)
1901–1918	[a] 46,239	705	$4,506,786	4.8	[b] 24,939	[b] $2,332,681	4.7
1919	[a] 6,029	.....	1,181,684	9.8	4,389	624,494	7.1
1920	10,942	560	2,021,356	8.8	3,740	532,635	7.1
1921	3,427	1,359	717,700	7.5	1,669	253,250	7.6
1922	8,905	1,122	1,475,229	7.4	1,081	162,494	7.5
1923	12,357	1,914	2,808,801	9.8	10,152	1,985,400	9.8
1924	12,270	2,183	2,655,015	9.2	8,877	1,597,433	9.0

[a] Part of the output in 1918 and 1919 was elemental arsenic, but the elemental arsenic produced in 1920 and 1921 is not included in the table, as it was reduced from white arsenic purchased on the market. No elemental arsenic was produced from 1922 to 1924.

[b] Imports for 1901 and 1902 (7,550 tons, valued at $596,580) include also arsenic sulphide. Separate figures not available.

[1] Figures for imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

IMPORTS

Arsenic compounds (other than white arsenic) imported for consumption in the United States, 1919–1924

Year	Arsenic and sulphide of, realgar, and orpiment		Sheep dip		Paris green and London purple	
	Short tons	Value	Pounds	Value	Pounds	Value
1919	2,151	$316,687	146,803	$12,346	18	$14
1920	4,080	684,016	70,168	5,150	772	277
1921	3,343	531,322	61,377	6,362	325	123
1922 [a]	3,815	472,044	70,390	4,877	3,866	741
1923 [b]	1,097	268,311	87,739	5,237	100,781	20,586
1924 [c]	234	45,246	114,801	10,764	76,241	15,683

[a] Also 41,296 pounds of "acid," valued at $4,195, and 22,487 pounds of "metallic arsenic," valued at $3,484, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to new tariff.

[b] Also 166,354 pounds of "acid," $15,597; 174,415 pounds of "metallic arsenic," $37,314; and 26 pounds of "lead arsenate," $9.

[c] Also 420 pounds of "acid," $121; 122,467 pounds of "metallic arsenic," $23,684; 3,585 pounds of "lead arsenate," $525; and 3,172 pounds of "calcium arsenate," $278.

White arsenic imported into the United States in 1924, by countries and districts

[General imports]

Country	Short tons	Value		District	Short tons	Value
		Total	Average (cents per pound)			
Belgium	570	$129,363	11.3	Vermont	2	$161
France	11	2,842	12.9	Buffalo	518	96,266
Germany	875	145,373	8.3	New York	6,593	1,203,952
Greece	719	134,675	9.4	Philadelphia	83	18,191
Netherlands	(a)	91	16.5	San Antonio	20	3,194
England	290	68,496	11.8	El Paso	28	4,488
Canada	1,257	230,134	9.2	Los Angeles	48	7,316
Mexico	1,900	274,297	7.2	San Francisco	821	123,701
Dominican Republic	38	4,483	6.0	Oregon	1	162
China	217	41,806	9.6	Michigan	455	79,787
Japan	2,713	504,228	9.3	Chicago	14	3,441
Australia	262	55,350	10.6	Ohio	269	50,479
	8,852	1,591,138	9.0		8,852	1,591,138

[a] 551 pounds.

Dealers reported exports of white arsenic, lead arsenate, cattle dip, and sodium arsenate, but no figures are available in the Bureau of Foreign and Domestic Commerce. Most of the exports consisted of imported and domestic white arsenic, which was shipped to Canada and Hawaii.

ARSENIC MARKET IN 1924

DEMAND AND SUPPLY

In spite of the marked decline in price, production of arsenic in 1924 was considerably in excess of that in 1923. Although the "higher cost" properties were idle during most of the year, the total production equaled the forecast made a year ago of the amount necessary to meet the normal increase in demand. This increase, however, was below normal, and a considerable stock of white arsenic awaits utilization in 1925.

Nearly two-thirds of the white arsenic produced in the United States in 1924 came from plants where the ore was directly treated for its arsenic content. The remaining third of the total domestic output, partly estimated, was the by-product from the regular ore charges of copper and lead smelting, to which was added some arsenic recovered by a manufacturer of chemicals.

According to the annual report of the American Smelting & Refining Co., most of the white arsenic it produced in 1924 was high-cost arsenic from its refiners at Globe, Colo., and Tacoma, Wash. Only a small part of its total output (10,473 tons) was by-product arsenic, and most of that originated at its smelter at San Luis Potosi, Mexico.

Imports during 1924 were 8,877 short tons of crude and refined arsenic, and the total new supply in the United States in 1924, therefore, was 29,054 tons. The principal sources of the recovered arsenic in the United States in 1924 were Utah, Nevada, Montana, South Dakota, Colorado, California, New Mexico, and Arizona. Arsenical ores were mined in each of these States, and with the by-product recovered from miscellaneous ores and concentrates, were converted into white arsenic at refineries in Tacoma, Wash.; Globe, Colo.; Murray and Midvale, Utah; Anaconda and Jardine, Mont.; Martinez, Calif.; Perth Amboy, N. J.; and Keystone, S. Dak. The chief producers operating arsenic refining furnaces and kitchens were the American Smelting & Refining Co., the United States Smelting, Refining & Mining Co. (Inc.), the Anaconda Copper Mining Co., International Smelting Co., Jardine Mining Co., Toulon Arsenic Co., Chipman Chemical Engineering Co., and the Keystone Arsenic Co.

Two-thirds of the imports of white arsenic came from Japan, Mexico, and Canada, as shown in the table on page 36.

PRICES

From January to December the price of white arsenic dropped 50 per cent. The published price of white arsenic quoted in New York ranged from 13½ cents a pound in January to 11¾ cents at the end of March, and was about 8¼ cents during June and July. Later the price dropped gradually until October, when 6½ cents was bid and 7 cents was asked. In November and December there was a slight demand, with offerings at 6¾ cents a pound delivered. The price of imported arsenic varied, with Japanese material at 6¼ cents a pound on spot in November and European at 6½ cents a pound. Metallic arsenic was quoted at 45 cents a pound and red arsenic at 15 cents a pound throughout the year. Calcium arsenate slumped from 13 cents a pound in January to 9 cents in September, and was quoted at 8 cents bid and 9 cents asked the remainder of 1924. Lead arsenate held steady at 18 to 20 cents a pound until the middle of May and 16 to 18 cents the rest of the year. The high and low prices for white arsenic, together with comparisons for the last six years, were:

Year	High	Low	Year	High	Low	Year	High	Low
1919	$0.10	$0.08	1921	$0.10	$0.055	1923	$0.16	$0.0825
1920	.16	.10	1922	.155	.06	1924	.135	.06

CENSUS OF MANUFACTURE OF ARSENIC COMPOUNDS

The Bureau of the Census, after the close of the year ended June 30, 1924, made a special census of calcium arsenate to determine the output for that year. The resulting statistics, although admittedly not comprehensive, were summarized by the Bureau of the Census as follows:

There were produced during the year ended June 30, 1924, 43,625,000 pounds of calcium arsenate, an increase of 19.6 per cent as compared with 36,481,000 pounds for the year ended June 30, 1923; 21,004,000 pounds of lead arsenate, an increase of 38.5 per cent as compared with 15,161,000 pounds for the preceding year; and 6,092,600 pounds of Paris green, an increase of 28.4 per cent as compared with 4,746,000 pounds for the preceding year. Based on the figures published by the United States Geological Survey in its bulletin "Arsenic in 1923," the consumption of white arsenic in the manufacture of these compounds amounted to 28,080,000 pounds, of which total 17,958,000 pounds was used in the production of calcium arsenate, 6,605,000 pounds for lead arsenate, and 3,517,000 pounds for Paris green. During the year these manufacturers purchased 32,245,000 pounds of white arsenic. The excess of the quantity purchased over the quantity consumed in the manufacture of calcium and lead arsenates and Paris green was due to consumption in the production of other arsenic compounds, sales of arsenic as such, and probably an increase in stocks.

The figures are based upon the data for 23 establishments. Because of the failure of a number of manufacturers to report, estimates were used in the determination of the quantity of arsenic purchased and the production of the respective compounds, these estimates being based upon the ratios which the totals of the reports received bore to the totals for the same establishments as reported to the United States Geological Survey for the calendar year 1923. During the year ended June 30, 1924, calcium arsenate was produced by 18 establishments, lead arsenate by 18 establishments, and Paris green by 8 establishments.

ARSENICAL ORES

OUTPUT AND TREATMENT

Active search for arsenical ore deposits was begun during 1923 in eight western States and resulted in the production in 1924 of 52,198 tons of ore, concentrate, and old arsenical speiss, containing the equivalent of 15,494 short tons of white arsenic (As_2O_3), of which about 85 per cent was recoverable. Much of the ore mined remained in stock at roasting plants, but how much was not determined. Some of the ores mined were concentrated, the concentrate roasted, and the calcines containing gold, silver, and iron sold for smelting. Some calcines contained copper or lead in sufficient quantity to be paid for at the smelter.

The Jardine Mining Co., in Montana, reported calcines free from detrimental elements affecting the recovery of gold by cyanidation, and plans are under way to build the necessary addition to the reduction plant. The tailing from the cyanide plant was expected to be rich enough in iron and gold to pay for shipment to the smelter. In addition to the Jardine calcines some of the roasted ores and concentrate of the Irish Rose (Toulon) and White Caps mines, both in Nevada, and the Keystone mine in South Dakota were valuable enough to ship to the smelter. Only a few arsenic plants were prepared to buy ore and concentrates and to treat them. In ores containing other metals besides arsenic, payment for the other metals was made if they exceeded a valuation of $7 to $10 a ton. The arsenic in some ores was paid for by certain buyers on the basis of

metallic arsenic as low as 5 cents a pound and by other buyers on the basis of arsenious oxide as low as 3 cents a pound. The prices varied according to the fluctuations in the New York quotations for white arsenic. The buyers of arsenic ores were the Chipman Chemical Engineering Co., making weed-killing solutions at Martinez, Calif., the Tacoma and Globe plants of the American Smelting & Refining Co., and the Toulon Arsenic Co., at Toulon, Nev. Many owners of low-grade ores not amenable to concentration or so distant from one of the above plants as to incur heavy freight charges found little encouragement in the sale of their ores.

LOCAL REVIEWS

MONTANA

Anaconda.—By-product arsenic was produced at the reduction plant at Anaconda, Mont., and this supply of comparatively cheap arsenic will no doubt be available as long as operations are continued at the Butte mines. In 1924 the Anaconda Copper Mining Co., according to its annual report, produced 11,196,409 pounds of crude arsenic, of which 11,018,967 pounds was refined and 5,920,961 pounds was sold at an average of 9.4 cents a pound. Of the amount sold 118,817 pounds was disposed of as crude arsenic.

Jardine.—The Jardine arsenic plant operated continuously during the year, having increased its capacity by the addition of a 16-foot McDougall roasting furnace, large condensing kitchens, and a 12 by 20 foot refining furnace with kitchens. According to the annual report of the Jardine Mining Co., the crude and refined arsenic produced in 1924 sold for $134,162.37. In addition, gold bullion and gold in calcines sold for $178,288.47, or a total of $312,450.84.

NEVADA

Battle Mountain and Toulon.—At Toulon, Nev., operations at the concentrator and arsenic refinery of the Toulon Arsenic Co. were suspended June 1. The Irish Rose mine, near Battle Mountain, was also closed after having been in operation and shipping to Toulon from January to the end of May. All the white arsenic made at Toulon from Irish Rose ore and concentrates, with some custom material, was sold at the general average price of white arsenic for the year, but under a 10-cent market the company saw no advantage in operating.

The Irish Rose property is situated in the foothills at Copper Canyon in the Battle Mountain district, Lander County, 13 miles southeast of the Southern Pacific Railroad station, Battle Mountain, the supply point and post office of the district. Ore was mined from this property for many years for its content of silver, but only the closely sorted ore paid for shipment. In 1922 the Toulon Arsenic Co. began working the Irish Rose mine under lease and bond. Part of the ore was treated direct and some of it was concentrated at Toulon.

The ore deposits of the district occur in a series of quartzite and limestone intruded by porphyry. Veins formed along bedding planes of the sedimentary rocks may contain copper-gold, iron-zinc,

or silver-lead-arsenic ore. The latter predominated in the Irish Rose property, which is developed by a tunnel about 600 feet long driven on the vein with stopes and upraises. The vein developed by this tunnel is said to be several hundred feet long and pinches and widens from 6 inches to 3 feet. The milling ore averages 8 per cent of arsenic, about 80 cents in gold, and 5 ounces of silver to the ton, 2 per cent of lead, 11 per cent of sulphur, 13 per cent of iron, and 45 per cent of insoluble. The ratio of concentration is 3 into 1. The ore directly roasted is much higher in arsenic, averaging 15 per cent. According to a conservative estimate the ore reserves above the tunnel level amount to about 60,000 tons. In 1924 ore was hauled 8 miles by auto trucks from the mine to the railroad for $2.25 a ton and by rail to Toulon for $1.40 a ton.

Antelope or Cedar district.—Veins of arsenical ore occur in the Antelope or Cedar district, Pershing County, Nev., which is situated in the northern part of the Trinity Range, 25 miles west of Imlay on the Southern Pacific Railroad. Most of the ore from this district was shipped from Humboldt House, which was 5 miles nearer the mine. Altogether about 700 tons of arsenic ore was mined, nearly half of it going to the Toulon arsenic furnaces before they were shut down in June and the remainder to the weed-killer plant at Martinez, Calif., until it was closed by fire in August. The Majuba Hill copper mine is the principal mine in this district and the veins of arsenical ore lie immediately west of it near the summit of the range at altitudes of 6,300 to 6,650 feet. The ore crosscuts the cleavage planes of the Triassic slate and in places parallels the bedding of the slate. The veins are narrow, ranging from a few inches to 3 feet, and stand almost vertical. Arsenopyrite is the chief sulphide mineral and is occasionally accompanied by a little galena, which is colored bright yellow by oxidation. Silver, gold, and lead were contained in the ore shipped, but not in sufficient quantity to meet the schedule of the ore buyer. According to the unpublished notes by F. C. Lincoln, of Rapid City, S. Dak., arsenic-lead-silver and gold are distributed irregularly in the veins, and there appears to be no quantitative relation between the metals. In nine samples assayed the arsenic ranged from 8 to 36 per cent; lead, 3 to 11 per cent; silver, 0.2 ounce to 16.3 ounces; and gold, a trace to $5.60 a ton.

Eureka district.—From the old dump at Eureka, Nev., now practically exhausted, 12,522 tons of speiss was produced which averaged 30 per cent of arsenic and contained gold, silver, and lead. Part of the speiss was stored at Palisade and the balance shipped to Midvale, Utah.

Other districts.—Arsenical ores were also mined in the Manhattan and Silver Star districts, at Holbrook, Steamboat Springs, Carson City, and near Fallon. Most of the ore from these districts was treated at the arsenic plant at Martinez, Calif., which also received arsenical ore from Colorado, New Mexico, Arizona, and California. The white arsenic recovered from the ores roasted was made into weed killer (sodium arsenite) and was sold to railroad companies on the Pacific coast. At Pittsburg, Calif., calcium arsenate was made from white arsenic recovered from ores purchased the previous year in Nevada and California.

SOUTH DAKOTA

Keystone.—During the year the new roaster and arsenic kitchens of the Keystone Arsenic Co. were completed; they treated arsenical concentrate containing considerable gold. A little white arsenic was sold.

UTAH

Gold Hill.—The greatest reserve of arsenic ore thus far developed in the United States is at Gold Hill, Tooele County, Utah, the terminus of a branch from Wendover on the main line of the Western Pacific Railroad. Smelting companies own or lease two groups of claims which have deposits containing several hundred thousand tons of arsenopyrite and scorodite ore, insuring the arsenic plants a supply large enough for a number of years. The freight rate on this class of ore from Gold Hill to the roasting furnaces of the smelters near Salt Lake City is not high, but at the present cost of mine operations little or no profit is said to accrue when white arsenic is quoted below 7 cents a pound. (The shipment of arsenical ore from Gold Hill was discontinued in January, 1925.)

About 30,000 tons of mixed scorodite and arsenopyrite, as well as some lead ore, was shipped in 1924 from the mine of the Western Utah Copper Co., which is leased to the American Smelting & Refining Co. Most of the arsenic ore and all the lead ore were treated at the company's smelter at Murray, Utah, and some of the arsenical ore was shipped to its smelter at Tacoma, Wash. The calcium arsenate plant of the Salt Lake Insecticide Co. received scorodite ore from Gold Hill during the first two months of 1924, but later, as the price of arsenic receded, the plant was closed for an indefinite time. The Western Utah Copper mine was developed to a deeper level in 1924, and on its 760-foot drift the deposit of arsenopyrite and lead ore was more valuable than on levels above. The ore mined is loaded directly from the bins to the railroad cars at the mine.

Early in 1924 the United States Exploration & Mining Co. relieved the Grasselli Chemical Co. of its option on the Last Dollar (Gerster) claims and at the same time leased adjoining ground. A large deposit of arsenopyrite with some scorodite had been opened in 1923 by a 60-foot shaft, which was sunk to a depth of 100 feet by the new owner, and followed into the adjoining Lost Cabin and Goldstone patented claims. Development of this ore deposit was continued from the bottom of the shaft; during development it was connected with a 200-foot tunnel, and all the necessary working equipment, including blacksmith shop and ore bins, was placed at the tunnel portal.

All the ore mined in 1924, amounting to approximately 10,000 tons, came from above the tunnel level. Some of the ore averaged 38 per cent of arsenic by the car lot, but the general average of the total output was 25.8 per cent of arsenic, 30 per cent of insoluble, 20 per cent of iron, 12 per cent of sulphur, 0.5 per cent of lime, 0.4 per cent of zinc, 0.02 per cent of copper, and 0.86 per cent of lead. The gold averaged 0.03 ounce and silver 1.6 ounces to the ton.

Considerable low-grade oxidized lead ore, closely associated with the arsenopyrite, was also mined and several cars shipped to the

smelter. The lead ore contained 10 to 16 ounces of silver and 6 to 13 per cent of lead and averaged 7 per cent of metallic arsenic. The ore was loaded from the bins at the portal of the mine tunnel and hauled 1¼ miles to the railroad.

Tooele.—The International plant at Tooele, Utah, in 1924 produced 500.84 tons of crude arsenic, averaging 92.15 per cent of arsenious oxide, which was shipped to Anaconda for refining.

WORLD'S PRODUCTION

Judging from the quantity imported, the foreign production of white arsenic during the first half of 1924 continued at about the same rate as in 1923. In June the severe slump in the price of white arsenic caused a big decrease of imports from all countries except Canada. Both Canada and Mexico were continuous shippers; in August the latter increased its exports to the United States and in November doubled them. Producers in several countries stopped all shipments to the United States before the end of 1924. The principal foreign countries producing white arsenic are shown in the accompanying table, but the output for 1924 is not available.

World's production of arsenic ore and white arsenic, 1919–1923, in metric tons

Country	1919	1920	1921	1922	1923
Ore					
Australia:					
New South Wales	6	(a)	1,117	(a)	11,677
Queensland (arsenical pyrites)	(a)	(a)	(a)	2,596	(a)
Victoria	(a)	(b)	(b)	(b)	(b)
Western Australia (ore exported)		1,793	7	1,092	(b)
Austria [c]	(b)	46	54	103	553
Belgium	(a)	(b)	(b)	(a)	(a)
Brazil		(a)	(a)	(a)	(a)
Canada	(a)	(a)	(a)	(a)	(a)
China (exports of realgar)	225	472	258	549	413
Chosen	(b)	(b)	(b)	56	26
Czechoslovakia (arsenical pyrites)					24
France	600	582	1,980	790	4,245
Germany	4,779	6,281	7,033	(a)	(b)
Greece	(a)	(a)	(a)	(a)	(a)
Italy	3		60	450	206
Japan	968	2,173	1,506	2,295	[d] 4,245
Mexico	(a)	(a)	(a)	(a)	(a)
Norway	20				577
Portugal	62	62	11	(b)	(b)
Rhodesia, Southern	(a)	(a)	(a)	(a)	(a)
Spain (arsenical pyrites)	150	1,000			
Switzerland	(b)	(b)	39	10	(b)
Turkey	162	14	(b)	200	(b)
Union of South Africa	(a)	(a)	(a)	(a)	(a)
United Kingdom (arsenical pyrites)	76	1,197	(a)	360	741
United States	(a)	(a)	(a)	(a)	(a)
White arsenic					
Australia:					
New South Wales	(e)	71	403	296	367
Queensland	59	310	224	406	620
Victoria	1,041	(b)	(b)	(b)	(b)
Western Australia		(e)	(e)	(e)	(b)
Austria	(b)	(e)	(e)	(e)	(e)
Belgium	50	(f)	(f)	1,008	1,380

[a] White arsenic reported.
[b] No data available.
[c] Arsenic slimes, production of one gold mine in Salzburg, with estimated arsenic content as follows: 1920, 7 tons; 1921, 11 tons; 1922, 45 tons; 1923, 101 tons.
[d] Incomplete figure.
[e] Ore reported.
[f] No data of production are available. Declared exports of arsenic from Belgium to the United States were in 1920, 463 tons; in 1921, 485 tons, but no statement was made as to how much of this was of Belgian origin.

World's production of arsenic ore and white arsenic, 1919–1923, in metric tons—Continued

Country	1919	1920	1921	1922	1923
White arsenic—Continued					
Brazil		127	127	134	162
Canada	3,075	2,231	1,353	2,337	2,912
China (exports)	58	49	100	30	176
Chosen	(b)	(b)	(b)	(c)	95
Czechoslovakia					(c)
France	735	606	328	425	(c)
Germany [g]	1,475	2,077	2,342	2,000	(c)
Greece	686	854	768	967	1,176
Italy	(c)		(c)	(c)	(c)
Japan	835	933	1,395	1,922	4,287
Mexico	2,246	[h] 2,183	785	[i] 272	1,402
Norway	(c)				(c)
Portugal	536	653	268	(b)	(b)
Rhodesia, Southern	220	396	327	451	774
Spain	42	76			(b)
Switzerland	(b)	(b)	(c)	(c)	(b)
Turkey	(c)	(c)	(b)	(c)	(c)
Union of South Africa	7	10	2	3	5
United Kingdom	2,568	2,029	1,049	994	1,631
United States	5,469	10,434	4,342	9,096	12,946

[b] No data available.
[c] Ore reported.
[g] Estimated arsenic in ore.
[h] Output of Mapimi smelter. Data furnished by company.
[i] Mexican Government figure. The Penoles Co. reports 335 tons shipped in 1922.

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PLATINUM AND ALLIED METALS

By James M. Hill[1]

CRUDE PLATINUM

Mine returns for 1924 indicate a production of 28 troy ounces of crude platinum in Alaska, 285 ounces in California, 20 ounces in Oregon, and 2 ounces in Utah, a total of 335 ounces for the United States. In 1923, Alaska produced 7 ounces, California 578 ounces, and Oregon 24 ounces.

Platinum refiners report purchases of domestic platinum in 1924 as follows: Alaska, 5 ounces; California, 161 ounces; Oregon, 24 ounces; and Utah, 2 ounces—a total of 192 ounces, which is 608 ounces less than was purchased by refiners in 1923. Refiners also report purchases of 64,479 ounces of foreign crude platinum in 1924—1,041 ounces from Australia, 5 ounces from Canada, 56,387 ounces from Colombia, and 7,046 ounces from Russia. As reported by the Bureau of Foreign and Domestic Commerce, the imports of platinum from Colombia during 1924 were 43,463 ounces, and the total imports of unmanufactured platinum 95,713 ounces, an increase of 10.8 per cent, as compared with imports in 1923.

REFINED PLATINUM METALS

NEW METALS

Reports of refiners of crude platinum, gold bullion, and copper indicate that 66,007 ounces of platinum metals were recovered from these sources in 1924, an increase of 16,210 ounces, or 33 per cent, as compared with recoveries in 1923. It is estimated that of the total quantity, 7,280 ounces was derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1920–1924, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1920	36,015	4,309	418	409	393	41,544
1921	51,791	2,686	286	581	1,026	56,370
1922	54,142	1,943	210	1,301	122	57,718
1923	46,780	1,934	280	787	16	49,797
1924	57,827	6,065	680	1,261	174	66,007

[1] Miss Helen M. Gaylord, of the Bureau of Mines, assisted in the preparation of this report.

New platinum metals recovered by refiners in the United States, 1923–24, by sources, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1923						
Domestic:						
Crude platinum	247		42	91	5	385
Ore	2	11				13
Gold and copper refining	1,865	1,176	33			3,074
	2,114	1,187	75	91	5	3,472
Foreign:						
Crude	44,318	255	205	696	11	45,485
Ore	32					32
Gold, nickel, and copper refining	316	492				808
	44,666	747	205	696	11	46,325
Total recovery	46,780	1,934	280	787	16	49,797
1924						
Domestic:						
Crude platinum	66		27	16	4	113
Ore		775				775
Gold and copper refining	3,457	2,893	26	16		6,392
	3,523	3,668	53	32	4	7,280
Foreign.						
Crude platinum	52,766	369	627	1,229	70	55,061
Ore	1,538	2,028			100	3,666
	54,304	2,397	627	1,229	170	58,727
Total recovery	57,827	6,065	680	1,261	174	66,007

SECONDARY METALS

Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures given in the following table undoubtedly contain some duplication, it is believed that they are worth publishing, for the secondary metals constitute a considerable proportion—23 per cent in 1924—of the total platinum metals available for consumption in the United States.

Secondary platinum metals recovered in the United States, 1920–1924, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1920	51,255	3,100	3,355		57,710
1921	39,131	4,887	1,776	229	46,023
1922	40,062	4,193	1,937	496	46,688
1923	39,152	6,246	2,021	453	47,872
1924	45,474	5,784	2,200	1,013	54,471

IMPORTS AND EXPORTS[2]

Platinum metals imported for consumption in the United States, 1923–24

Metal	1923			1924		
	Troy ounces	Value		Troy ounces	Value	
		Total	Average		Total	Average
Platinum:						
Ores of platinum metals (platinum content)	4,139	$428,317	$103.48	1,890	$207,905	$110.00
Grains, nuggets, sponge, or scrap	46,713	4,711,687	100.86	61,952	5,937,792	95.85
Ingots, bars, sheets or plates, not less than one-eighth inch thick	35,565	3,783,033	106.37	31,871	3,678,416	115.42
	86,417	8,923,037	103.26	95,713	9,824,113	102.64
Manufactures of, except jewelry	103	4,769	46.30	17	2,367	139.24
Iridium	1,611	276,539	171.66	1,397	214,384	153.46
Osmiridium	1,174	150,074	127.83	1,446	174,460	120.65
Osmium	1,462	147,154	100.65	350	38,931	111.23
Palladium	14,578	857,071	58.79	10,388	624,478	60.12
Rhodium	805	86,569	107.54	1,166	105,770	90.71
Ruthenium	487	21,492	44.13	882	45,846	51.98
	106,637	10,466,705	98.15	111,359	11,030,349	99.05

Platinum metals imported into the United States in 1924, by countries, in troy ounces

[General imports]

Country	Platinum (grains, scrap, ingot, etc.)	Palladium	Iridium	Osmium and osmiridium	Rhodium and ruthenium	Total
Africa (British West)	59					59
Argentina	32					32
Australia				338		338
Brazil	206					206
Canada	787	619			210	1,616
Ceylon	1			2		3
China	166					166
Colombia	43,463	1	1	24		43,489
Cuba	4					4
England	37,253	9,743	1,248	1,019	1,237	50,500
France	7,983		138	336	601	9,058
Germany	199					199
Ireland	27					27
Japan		25	10	77		112
Latvia	4,068					4,068
Mexico	34					34
Netherlands	237					237
Panama	192					192
Poland and Danzig	198					198
Spain	103					103
Sweden	689					689
Venezuela	12					12
	95,713	10,388	1,397	1,796	2,048	111,342

The metal imported from Panama and Colombia is crude, and the imports from Latvia, Poland, and Sweden are believed to be crude and of Russian origin. Part of the metal from England, France, and Germany is doubtless Russian crude, but the bulk is probably refined metal. The total value of platinum metals imported for consumption in 1924 was $11,030,349.

[2] Data for imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Platinum exported from the United States, 1920–1924

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1920	1,302	$177,115	(a)	$111,014
1921	3,272	244,473	741	85,216
1922 Crude, scrap, and old	143	13,149	486	35,967
1922 Ingots, sheets, wire, and alloys	1,313	127,047		
1923	1,151	128,599	592	65,073
1924	5,854	643,282	1,274	136,948

[a] Quantity not given.

CONSUMPTION

The consumption of platinum metals in the United States in 1924, as reported by refiners, was 165,018 ounces, a decrease of 14 per cent as compared with 1923. The chemical industry increased its consumption 1,890 ounces, most of which was platinum. The electrical industry used 2,981 ounces less and the dental industry 5,285 ounces less than in 1923. The jewelry industry reduced its consumption by more than 21,000 ounces, but used more osmium and rhodium than formerly.

It will be noted that the figures for consumption of platinum metals, calculated by two methods shown in the following tables for the year 1924, check rather closely as to total and for platinum. The figures for 1923 have been revised as more detailed information concerning imports is now at hand, but even with this change the estimates are still far apart for that year.

Platinum metals consumed in the United States as reported by refiners, 1923–24, by industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1923						
Chemical	8,637	485	190	266	9,578	5
Electrical	18,596	3,666	1,675		23,937	13
Dental	16,288	10,116	153		26,557	14
Jewelry	105,699	14,948	3,073	190	123,910	65
Miscellaneous	3,156	986	1,403	1,256	6,801	3
	152,376	30,201	6,494	1,712	190,783	100
1924						
Chemical	10,507	436	122	403	11,468	7
Electrical	16,588	3,099	1,269		20,956	13
Dental	11,092	10,049	131		21,272	13
Jewelry	87,151	12,480	2,204	746	102,581	62
Miscellaneous	5,012	2,122	634	973	8,741	5
	130,350	28,186	4,360	2,122	165,018	100

Apparent supply of platinum metals in the United States, 1923–24, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1923					
Stocks Jan. 1	41,900	24,975	7,559	1,583	76,017
New metal produced	46,780	1,934	280	803	49,797
Secondary metal produced	39,152	6,246	2,021	453	47,872
Imports	35,565	14,578	1,611	3,928	55,682
Total available	[a] 163,397	47,733	11,471	6,767	[a] 229,368
Stocks Dec. 31	36,554	26,266	5,208	2,697	70,725
Apparent supply	[a] 126,843	21,467	6,263	4,070	[a] 158,643
1924					
Stocks Jan. 1	36,554	26,266	5,208	2,697	70,725
New metal produced	57,827	6,065	680	1,435	66,007
Secondary metal produced	45,474	5,784	2,200	1,013	54,471
Imports	31,871	10,388	1,397	3,844	47,500
Total available	171,726	48,503	9,485	8,989	238,703
Stocks Dec. 31	40,464	27,400	3,622	3,053	74,539
Apparent supply	131,262	21,103	5,863	5,936	164,164

[a] Revised figures.

STOCKS

Stocks of the platinum metals in the hands of refiners on December 31, 1924, amounted to 74,539 ounces, an increase of 5 per cent as compared with the stocks at the beginning of the year.

Stocks of platinum metals in the hands of refiners in the United States, December 31, 1920–1924, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1920	46,747	16,565	3,196	216	67,724
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539

MARKET AND PRICES

CRUDE PLATINUM

Sellers of domestic crude platinum reported they were paid for metal content based on assay, and no figure can be given for crude platinum. Buyers reported purchases at $93 to $122 an ounce for domestic and $94 to $114 for foreign crude platinum. Buyers of foreign and domestic crude platinum in the United States who reported purchases in 1924 are listed below:

American Platinum Works, 325 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co. (Inc.), Murray and Austin Streets, Newark, N. J.
J. Bishop & Co., Malvern, Pa.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Thomas J. Dee & Co., 1010 Mallers Building, Chicago, Ill.
Goldsmith Bros. Smelting & Refining Co., 20 John Street, New York, N. Y., and 907 Hayworth Building, Chicago, Ill.
S. B. Gracier (Inc.), 608 Commercial Street, San Francisco, Calif.
Interstate Smelting & Refining Co., 29 Commercial Street, Newark, N. J.
Johnson Matthey & Co., Woolworth Building, New York, N. Y.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, 814 South Spring Street, Los Angeles, Calif.
R. & H. Platinum Works, 709 Sixth Avenue, New York, N. Y.
Shreve & Co., Post Street and Grant Avenue, San Francisco, Calif.
L. F. Waterman Co., New York, N. Y.
Wildberg Bros., 742 Market Street, San Francisco, Calif.

REFINED METALS

The quoted prices [3] for refined platinum remained within the limits of $115 to $125 an ounce throughout the year; they were lowest in April and May, rose to $120 in August, and closed the year at $117. It is believed that the average selling price of the year was $118. Iridium began the year at $275 to $300 an ounce, declined to $260 to $270 by June, and rose to $325 in December with supplies very short; the average selling price was approximately $285. Palladium opened the year at $82 and declined to $78 in June; the average selling price was $83. Osmium sold at $100, rhodium at $100, and ruthenium at $60 throughout 1924. The 5 per cent iridium alloy sold at an average of $128 an ounce, and the 10 per cent alloy at $137 an ounce.

WORLD'S PRODUCTION

Estimated world's production of crude platinum from placers, 1915–1923, in troy ounces

Country [a]	1915	1916	1917	1918	1919	1920	1921	1922	1923
Australasia:									
New South Wales	56	82	259	607	213	796	249	80	586
Papua (osmiridium) [b]	(b)	(b)	(b)	(b)	(b)	100	360	100	115
Tasmania (osmiridium)	247	222	332	1,607	1,670	2,009	1,751	1,174	673
Canada [c]	100	60	80	40	30	25	15	15	10
Colombia [d]	18,000	25,000	32,000	35,000	35,000	35,000	35,500	40,000	42,000
India (British)	18	9	4	(e)					
Japan		70	127	51	155	258	231	150	224
Russia [d]	124,000	63,900	50,000	25,000	30,000	35,000	20,000	22,000	20,000
Union of South Africa (osmiridium)	(f)	(f)	(f)	(f)	(f)	(f)	510	762	1,784
United States	742	750	605	647	824	613	977	1,008	609

[a] In addition to the countries listed, Brazil exported 700 grams (23 ounces) in 1915.
[b] Year ended June 30. Prior to 1920 annual production had not exceeded 10 ounces.
[c] Estimate by J. M. Hill; Canada Dept. Mines Ann. Repts. and Dominion Bureau of Statistics Ann. Repts. give the following figures: 1915, 23; 1916, 15; 1917, 57; 1918, 39; 1919, 25; 1920, 17; 1921, 23; 1922, 12; 1923, 7.
[d] Estimate by J. M. Hill.
[e] Production, 0.31 ounce.
[f] Data not available.

The following table gives data by which the figures showing the production of crude platinum as given above can be reduced to terms of the refined metals used by the industries:

Average assay of crude platinum, in per cent

Country	Platinum	Palladium	Iridium	Osmium	Rhodium, ruthenium, etc.
Australasia:					
New South Wales	75.9		1.3		1.3
Papua			58.1	33.5	3.0
Tasmania			58.1	33.5	3.0
Canada	72.1	0.2	1.1		2.8
Colombia	96.2	.5	1.1		1.4
Japan	.2		49.8	37.3	3.9
Russia	83.5	1.9	1.9	3.0	.6
United States	85.5	.6	1.1	1.3	1.0

[3] Eng. and Min. Jour.-Press, vols. 117, 118, 1924.

PROPOSED STATUTORY DEFINITION OF PLATINUM

Although there has been much discussion[4] of the question of proper stamping of platinum jewelry, final action in the matter has been postponed until 1925. Early in 1925 a test case was started in New York to determine the proper legal marking of white gold and platinum-coated white gold[5] under the New York stamping law.

METALLURGY

The Bureau of Standards[6] has issued a report giving details of a study of the various analytical methods used to determine the presence of iridium in platinum alloys and offers a modified method which "combines the optimum conditions for speed and accuracy."

Two papers[7] of interest in connection with the use of osmium for hardening platinum show that, although osmium fumes are dangerously poisonous, the metal can be used to advantage if proper precautions are taken.

The McBride amalgamator[8] has been proposed for use on dredges as a clean-up device for saving fine gold and platinum. The device is somewhat on the principle of a log washer, but is equipped with an electric device that liberates chlorine from the sea water that is used, thereby removing grease, breaking up rust, and forming sodium amalgam, which holds the platinum grains.

NOTES ON PLATINUM DEPOSITS

UNITED STATES

The Salt Chuck mine, Prince of Wales Island, Alaska, was again in operation during the year and early in 1925[8a] was reported as shipping 30 tons of palladium-bearing copper concentrates a month. At various placers in Alaska a total of 28 ounces of crude platinum was recovered.

In California the production of crude platinum further declined to 285 ounces, as compared with 578 ounces in 1923. The dredges along the base of the Sierras were the largest producers, the output coming from Sacramento, Yuba, Stanislaus, Butte, Calaveras, and Shasta Counties, named in the order of their relative output. Although much sniping was done on various streams as a result of extremely low water, little platinum was recovered.

At the Jesse No. 1 placer, at Island Park, Gold Butte district, Toole County, Mont., a little crude platinum was saved in 1924.

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[4] See various editorials and articles in the Jewelers Circular for 1924, particularly Hill, J. M., Some thoughts on the platinum section of the proposed national marketing act; vol. 88, Mar. 26, 1924, p. 57. Important conference on making of white gold and platinum held in New York; vol. 88, Apr. 30, 1924, pp. 87–89. Editorial, vol. 88, Feb. 25, 1925, p. 86.
Hoke, C. M., Some aspects of the platinum stamping law; vol. 88, May 28, 1924, pp. 79–81.
Hill, J. M., Platinum stamping legislation: Eng. and Min. Jour.-Press, vol. 117, May 17, 1924, pp. 800–802.
———, Sterling marks for platinum: Chem. and Met. Eng., vol. 30, June 9, 1924, pp. 912–913.
Metal Industry: Some aspects of the platinum stamping law; vol. 22, Sept., 1924, p. 362.
Engelhard, Chas., The platinum-palladium controversy in its relation to the jewelry industry, Baker & Co., Newark, N. J.

[5] Jewelers Circ., vol. 90, Mar. 4, 1925, pp. 67 and 109; Mar. 25, 1925, pp. 59 and 91; Apr. 8, 1925, pp. 80–81; Apr. 29, 1925, pp. 91–93.

[6] Gilchrist, Raleigh, Determination of iridium in platinum alloys by the method of fusion with lead: B. S. Sci. Paper 483, Feb. 28, 1924, 23 pp.

[7] Wright, T. A., Is there danger to the jeweler who melts osmium?: Jewelers Circ., vol. 88, May 28, 1924, p. 69. Chemical and Metallurgical Engineering, Is osmium poisonous?: Chem. and Met. Eng., vol. 31, Nov. 10, 1924, p. 743.

[8] Neill, J. W., McBride amalgamation process uses novel machine: Eng. and Min. Jour.-Press, vol. 117, May 17, 1924, p. 825.

[8a] Mining Truth, 10th year, No. 2, February, 1925, p. 15.

In Oregon 20 ounces of crude platinum was recovered by miners in 1924, as compared with 24 ounces in 1923. The largest production was made at Sixes, Curry County, and next in importance was the Esterly placer on Illinois River, near Waldo, Josephine County, and finally the beach near Bullards, Coos County.

So far as has been learned, no concentrates were shipped from the Rambler mine, in Albany County, Wyo., in 1924. Nothing has been heard of the properties near that town which were loudly acclaimed in 1923.

AUSTRALASIA

It is reported [9] that deposits carrying osmiridium are becoming scarce in Tasmania. The report seems to be confirmed by the continued decrease in production. Nothing has been heard recently concerning osmiridium in the Province of Papua. Apparently there is a chance to develop dredging fields in Papua as soon as transportation conditions are improved.[10]

CANADA

Some interesting statistics of platinum metals derived from the Sudbury nickel-copper ores have been given.[11] These are of particular interest because the figures include for the first time the recoveries of the Mond Nickel Co., whose refinery is at Swansea, Wales. The following table is compiled from the Canadian report.

Precious metals recovered by nickel-copper refineries treating Ontario matte, 1920–1924

	1920	1921	1922	1923	1924
Bessemer matte produced ..... short tons	.....	19,498	17,324	58,084	65,943
Matte exported ..... do	.....	10,466	19,831	21,450	26,565
Matte refined in Canada [a] ..... do	.....	5,558	10,340	31,765	37,613
Metals recovered from above:					
Gold [b] ..... troy ounces	1,261	4,537	2,094	3,574	4,125
Silver ..... do	119,839	50,341	50,239	100,982	122,889
Platinum ..... do	8,345	5,412	4,802	6,810	9,181
Palladium ..... do	10,199	7,729	6,862	8,511	8,923
Rhodium, ruthenium, osmium, and iridium ..... do	522	277	124	304	593

[a] Refining in Canada began at Port Colborne, Ontario, in 1918 and at Deschenes, Quebec, in 1920.
[b] Includes small recoveries of Rh, Ru, Os, and Ir by the Mond Nickel Co.

There has been considerable activity in the Tulameen district, British Columbia, during the last year in preparation for operation on some of the bench gravels.

COLOMBIA

The estimated output of platinum in Colombia in 1923 was 42,000 ounces. It is believed that at least 46,000 ounces was produced in 1924, of which over 50 per cent came from native washing.

The South American Gold & Platinum Co. stated in a letter to the author that it had produced 12,700 ounces of platinum in 1923, and during the first eight months of 1924 a total of 13,300 ounces

[9] Mining Journal (London), vol. 145, Aug. 9, 1924, p. 650.
[10] Mining Journal (London), The mining outlook in Papua; vol. 145, Mar. 8, 1924, p. 185.
[11] Preliminary report on the mineral production of Ontario in 1924, Dept. of Mines Bull. 53, p. 14, 1925.

was recovered by the three dredges of this company. Delays incident to operation in the Tropics and a shortage of labor resulted in slowing up the hydroelectric plant. It is expected, however, that dredges Nos. 2 and 3 will be operated by electric power early in 1925.

The report [12] of the British Platinum & Gold Corporation (Ltd.) for the year ended July 31, 1924, says that platinum valued at over £115,000 was extracted from 508,060 yards of gravel, most of which was dug by dredge No. 1. The No. 2 dredge began digging in May, 1924.

The Colombia Platinum & Gold Dredging Co., mentioned in the 1923 report, was not financed, though it is understood that some of its holdings were examined by dredge operators from California.

RUSSIA

The platinum output of Russia is still small and the quantity is uncertain. It is estimated that in 1923 the total may have reached 20,000 ounces. Early in 1925 the chief engineer of the Russian Platinum Trade Trust, Peter Drozgiloff, was in the United States to purchase new equipment for the Ural platinum mines. He stated in a letter to the author that during 1924 there were 25 dredges operating in the Urals, but he could not estimate the output. It was later [13] announced that five dredges had been ordered from the Yuba Manufacturing Co., of San Francisco, for shipment to Ekaterinburg by April, 1926.

UNION OF SOUTH AFRICA

Transvaal.—Since the change in metallurgical treatment of the Rand gold ores within the past two or three years, an increasing quantity of osmiridium has been recovered on the "corduroy tables." The production of osmiridium in 1923 from Transvaal was valued at £43,528 and in 1924 at £102,886.[14]

Watson [15] has given details of a method for osmiridium assay used in the South Africa fields.

Development has continued in the Waterberg area, 100 miles north of Pretoria, but nothing startling has been developed. A new field that seems more promising geologically has been opened in the Lydenburg area, 150 miles north of Johannesburg. The discovery was made in June, 1924, and development started in August, 1924. The most important discoveries were made in September, 1924, and in December the Government proclaimed three farms at the extreme north end of the belt as mineral land. The platinum occurs in ultrabasic igneous rocks of the Bushveld igneous complex, which outcrop in a belt 60 miles long. Various reports [16] have appeared concerning these deposits and apparently several well-financed prospecting ventures are under way. As has been stated, the geology is promising,

[12] Mining Magazine (London), vol. 32, January, 1925, p. 64.
[13] Eng. and Min. Jour.-Press, vol. 119, Apr. 25, 1925, p. 700.
[14] Commerce Repts., Apr. 6, 1925, p. 45.
[15] Watson, F. W., Osmiridium assay, South Africa Chem., Met. and Min. Soc. Jour., February, 1924. Abstract in Min. Mag. (London), vol. 30, May, 1924, p. 314.
[16] Wagner, P. A., Platinum deposits in the western part of the Lydenburg district, Transvaal, South African Jour. of Industries, February, 1925, vol. 8, No. 2, pp. 90–113.
Mining Magazine (London), vols. 30, 31, 32, 1924 and 1925, particularly vol. 32, April, 1925, pp. 239–245.
Letcher, Owen, World's "most prolific platinum producer" in South Africa, Eng. and Min. Jour.-Press, vol. 119, No. 14, April 4, 1925, pp. 573–575.
Jewelers' Circular, Discovery of platinum in South Africa, May 14, 1925, pp. 63–65.

but not enough development has been done to determine the ultimate worth of these discoveries.

Wagner [17] says in part:

For the greater part of its length the platinum belt has a north and south trend, but at its northern end it swings to the northwest in conformity with the strike of the rocks of the norite zone. It is bisected by the Steelpoort River, which divides it into a northern and a southern section. The precise extent of the fields is not yet known, as new discoveries are still adding to their already great area. * * * . The central part of the platinum area is situated in close proximity to the terminal stations of the newly opened Lydenburg-Olifantspoortje Railway, Steelpoort Station, the actual terminus, being within 10 miles of the area where the most important discoveries have been made. * * * .

The portion of the norite zone under review is from 14 miles to 25 miles in width and of a rugged mountainous nature. Rough-looking scrub-covered hills and ridges alternate with flat-bottomed valleys, the whole being dominated north of the Steelpoort by the Lulu Mountains, which with their great red bastions and grey precipices of norite afford some very fine scenery. * * * . While much of the area is covered with scrub, it can not be said to be well timbered. * * * . There are a number of occupied farms in the area, and there will thus be no difficulty in obtaining adequate supplies of cereals, fruit, and vegetables.

Three streams traverse the platinum fields. They are the Steelpoort, the Dwars, and the Mopatsi. The two first named are capable of being dammed and of yielding very large supplies of water. The Mopatsi is smaller. On the eastern slopes of the Lulu Mountains on the farm Maandagshoek No. 148 and also on Garatouw No. 467 are copious springs, yielding in each case about 100,000 gallons per day. Apart from the streams named and these springs, the northern part of the area is very poorly supplied with water, which, during the winter months, would have to be pumped from the Olifants River. It should be stated, however, that in many localities conditions appear to be favorable to the occurrence at shallow depths of fairly considerable underground supplies, which could be tapped by bore holes.

Geology.—The platinum occurs as a primary constituent of certain ultrabasic and basic rocks of the norite zone of the Bushveld Igneous Complex. This is an extensive irregular oval-shaped body of igneous rocks occupying the greater part of the central Transvaal, and extending from the western boundary of the Province to the central part of the Lydenburg district. It is composed in its outer or lower portion of norite and ultrabasic rocks and in its inner or upper portion of granophyre and red granite. * * * . Another feature of the norite zone is that the rocks composing it are, as a rule, pseudostratified to a remarkable degree, behaving exactly like well-bedded sedimentaries. The pseudostratification is parallel to the bounding surface of the sheet, and thus conforms in a general way with the strike and dip of the Pretoria beds.

The area under review is one in which the lower one-fourth of the norite sheet exhibits great heterogeneity, being made up of a considerable variety of rocks which, in conformity with the disposition of the Pretoria series, have a prevalent north-and-south strike and dip to the west at from 9.3 to 14°, the pseudostratification being throughout of the utmost regularity. The rocks composing this lower part of the sheet comprise bronzitites, chromite-bronzitite, harzburgite, dunites, serpentine, silicified serpentine, anorthositic norite, chromitite or chromite rock, and magnetite rock, to mention only the more important varieties. The chromitites in particular have attracted a good deal of attention of late, and an attempt is being made at the present time to work them on a big scale. In the central part of the platinum belt the chromite rock, which forms lenses and bands up to 6 feet in thickness, appears to follow two fairly definite horizons, the lower or main horizon lying from 75 to 400 feet below the upper. Small lenses of chromite rock occur between these two horizons and outside the limits given. It should also be stated that the chromite zone does not everywhere occupy the same position relative to the base of the norite sheet, there being fairly considerable variations in this respect.

The upper three-fourths of the norite zone, in contradistinction to the lower one-fourth, is of a very uniform character, being occupied mainly by mottled gray norites, except in its uppermost portion, where are great stratiform segregations of titaniferous magnetite associated with bands of anorthosite.

[17] Wagner, P. A., work cited.

Diabase dykes with a prevalent north-east-south-west trend intersect the rocks of the norite zone at many localities. On Driekop No. 170 a big body of tourmaline-bearing pegmatite cuts across the platiniferous norite.

Platinum occurrences.—The platinum occurrences of the area may be dealt with under the following heads: (1) Primary deposits, (2) eluvial and rubble deposits, and (3) alluvial deposits.

Primary deposits.—Within the limits of the area previously defined workable concentrations of platinum have been found on two horizons in the lower part of the norite zone. They may be referred to as (1) the lower or dunite horizon; (2) the upper or main horizon.

The lower horizon lies between the lower and upper chromite horizons. In it platinum is found as a primary constituent of remarkable iron-rich dunites occurring in isolated lenses, stratiform segregations, and irregularly shaped bodies. The dunites are associated with olivine-dunite, bronzitite, chromite-bronzitite, harzburgite, wehrlite, and serpentines evidently derived from normal magnesium dunites. Subordinate amounts of platinum are also found in these rocks. The upper horizon is situated some 1,600 feet above the lower. In it platinum is found in a very persistent sheet or layer of dark-colored, pseudoporphyritic pyroxenitic diallage norite, of variable grain and composition that originally contained small amounts of copper and iron pyrites, now represented at the surface by malachite and limonite. Platinum has also been found in several localities in rocks some little distance below and above the upper horizons.

Lower or dunite horizon.—On this horizon platinum occurs in small isolated lenses, segregations, and schlieren of iron-rich dunite, composed essentially of the variety of olivine known as hortonolite, a remarkable rock, wholly unlike any dunite hitherto described.

This rock is of striking appearance. As typically developed, it is a dark heavy rock weathering with a characteristic rustlike crust of brown or blackish-brown color. On freshly fractured surfaces the color ranges from deep honey-brown to greenish-brown. In hand specimens it appears to be very coarse-grained. Actually the grain is very uneven, and while one frequently sees hortonolite individuals up to 2 cm. and even 3 cm. long, the average grain measured in thin sections is only about 1.5 mm. It has the distinction of being the heaviest igneous rock composed essentially of silicates hitherto described from any part of the world, the specific gravity being 3.752. In some of the chromite-rich varieties the specific gravity is 3.9. One of the most remarkable features of the rock, as compared with other olivine rocks of the Bushveld complex, is its freshness, this being the more remarkable when, as on Mooihoek, it occurs in direct contact with serpentine evidently derived from the normal dunite composed of magnesia-rich olivine. As previously stated, it weathers with a brown or lustrous blackish-brown crust. This is never more than a millimeter or two in thickness, and immediately beneath it apparently unaltered hortonolite with characteristic greasy luster is always in evidence. The rock outcrops prominently. It is, as a rule, well jointed, and weathers in big rectangular blocks and slabs. These in the course of time become rounded at the edges and ultimately break up into smaller fragments that travel for considerable distances down the slopes of the hill on which it outcrops. Isolated pebbles of the rock are also found in the alluvial deposits.

Platinum is present in the dunite in well-shaped crystals, crystal aggregates, irregular rough grains, small nuggets, and spike-shaped forms often curved, in which the blunt end shows the faces of the cube. The metal is best studied in the rubble and eluvial wash derived from the disintegration of the rock. Only 1 grain of platinum was observed in rock collected in place. This is in a thin section of the Onverwacht dunite, which shows a small crystal of square outline, 0.015 mm. across, embedded in the peripheral part of a crystal of chromite, occurring at the contact of 2 grains of hortonolite. In panning eluvial wash there were, however, found, both on Onverwacht No. 330 and Mooihoek No. 147, large rounded grains showing crystals and irregular particles of platinum embedded in hortonolite or intergrown with that mineral. Some of the larger crystal aggregates of platinum also have grains of hortonolite adhering to them. The platinum nuggets found in the eluvial gravel are up to 5 mm. across; such large grains are uncommon, but crystals and crystal aggregates between 0.2 mm. and 1 mm. across are found in almost every panning. Much of the platinum, however, is very fine. Most of the larger grains and crystals of platinum from the eluvial deposits are covered with a thin film of ferric hydroxide. * * *.

Upper or main horizon.—On the upper or main horizon platinum, as previously stated, occurs in a remarkably persistent layer or sheet of dark-colored, mottled, pseudoporphyritic, pyroxene-rich diallage norite or felspathic pyroxenite,

generally showing green copper and brown iron stains. It lies roughly 1,600 feet above the dunite horizon in a zone of light-colored spotted norites and mottled anorthosites that occupy the broad flat-bottomed valley east of the Lulu Mountains and the Dwars River Range. The sheet varies in thickness from 3 to 40 feet. Where it is very thin, platinum appears to be distributed throughout its entire thickness. As a rule, however, it is concentrated in its uppermost portion. Copper and iron stains are confined to the platiniferous portion of the sheet. These stains owe their origin to the oxidation of grains of chalcopyrite, pyrite, and probably also pyrrhotite. It is thus apparent at the outset that there is some relation between the distribution of the platinum and that of the sulphides.

The platiniferous norite is exposed at intervals all the way from Twickenham No. 336 to Sterkfontein No. 221, a distance of over 50 miles. From the southern part of Hackney No. 237 to the southern boundary of Maandagshoek No. 148 the outcrop of the sheet can be traced practically without a break. It is also exposed on Onverwacht No. 330 and Eerste Geluk No. 348, but at the time of the writer's visit no systematic attempt had been made to trace the outcrop between Maandagshoek and Dwarsrivier No. 86, situated south of the Steelpoort, where it is again greatly in evidence. On some of the farms in this gap the location of the outcrop will be difficult owing to the presence of a considerable thickness of soil and alluvium.

South of the Dwarsrivier No. 86 the outcrop can again be traced almost without a break to Sterkfontein No. 221, a distance of some 16 miles. * * *. In the southern part of Dwarsrivier No. 86 and on Thorncliffe No. 217 the outcrop takes a turn to the southeast, but south of the latter farm it runs almost in a straight line, due north and south, down the western side of the valley of the Dwars River east to within a few miles of the sources of that river on Sterkfontein No. 221. The important question arises whether there is here a single sheet or a succession of sheets of norite. This question can not be answered definitely at present. What can be said, however, is that over very considerable distances the rock keeps to practically the same horizon, that for stretches of well over 2,000 yards it can be followed without a break, and that specimens taken from the southern part of the area are indistinguishable from those taken from the northern part.

The upper part of the sheet of mottled norite has, wherever properly tested, been found to carry platinum in amounts ranging from a trace to 7.5 pennyweight per ton. Over fairly considerable stretches the platinum content has been proved to average between 2 and 3 pennyweight and over shorter stretches over 3 pennyweight per ton. The platinum is present in the free state in minute grains and specks, which can easily be isolated by panning the crushed rock. The platinum content of the norite can thus be estimated fairly accurately by the length of the tail which it gives in the pan. Allowance must, however, be made for the fact that assays always show from 15 to 25 per cent more platinum than the tail obtained by panning would suggest. The discrepancy is evidently due to very fine platinum lost in the process of panning. The platinum is on the whole much finer than that from the dunite zone, and, speaking generally, is of a yellowish color. Bright silvery-white and dull-grayish specks are, however, often seen in the pan alongside the yellowish grains, so that it is probable that different combinations of the platinum metals are present. No analysis of the concentrate has so far been made. In addition to platinum, the norite carries small amounts of gold. This averages 5 per cent by weight of the platinum metals present. No well-formed crystals of platinum have so far been noted from this horizon.

As to the distribution of the platinum in the norite, very little is known. It appears to be fairly uniformly distributed over fairly considerable stretches of the outcrop, but even from the work done so far it is evident that some sections are richer than others. On Driekop No. 170 the outcrop can be followed without a break for 2,000 yards. The whole of the outcrop has been pegged by the Lydenburg Platinum (Ltd.), and Transvaal Consolidated Land and Exploration Co. (Ltd.). A stretch of 800 yards at the northern end of this long exposure has been sampled systematically by Doctor Merensky, and found to average between 2 and 3 pennyweight of platinum metals per ton. One 100-yard stretch averaged 3.4 pennyweight. The highest assay was 7.5 pennyweight of platinum and 2.5 pennyweight of gold. In the "Discovery" section, situated in the southern part of Maandagshoek No. 148, a 400-yard stretch has been tested by trenches and prospecting pits. Assay values ranged from 1.8 to 4.8 pennyweight over 2 to 4 feet. The full width of the ore body is apparently only exposed in a prospecting

shaft 7 feet deep. This was sampled in four sections, the average value disclosed by the sampling being 3.8 pennyweight over this width.

Eluvial and rubble deposits.—Owing to the highly resistant nature of the rock composing them, the deposits of platiniferous dunite on the lower horizon have, in proportion to their size, given rise to considerable accumulations of platiniferous eluvium and rubble. On the Mooihoek kopje and the slopes below it fully 3,000 tons of this material has been proved. It carries from 3 to 13.7 pennyweight of platinum per ton, and beyond the limits of the tested area there is probably considerably more. On the slopes of the Onverwacht knoll and on the slopes of the main ridge below there are also extensive accumulations of rubble carrying high platinum values. These are at present being tested systematically by regularly spaced potholes. On the slopes of Willems Kop there is a stretch of platiniferous rubble 300 yards long, which gives good values on panning. There are also accumulations of rubble, carrying platinum, below the big outcrop on Hendriksplaats, and such accumulations will doubtless be found wherever the dunite has been exposed to denudation. As fully 50 per cent of the platinum contained in these eluvial and rubble deposits is, as previously pointed out, present in the form of fairly large grained crystal aggregates and nuggets, its recovery should be very simple. The same applies to the finer platinum. It would probably pay, however, to screen off and crush the lumps of undecomposed dunite present, which could also be done very easily. The exploitation of these deposits should thus present no difficulties and yield very handsome profits. They are, unfortunately, of limited extent as detrital deposits are reckoned. No workable eluvial or rubble deposits have so far been found in connection with the main horizon, though grains of platinum can invariably be found in the soil below the outcrops of the pyroxenitic norite.

Alluvial deposits.—From the enormous denudation that has demonstrably taken place in this part of the norite zone and the great area covered by the platiniferous rocks, it might have been expected on *a priori* grounds that very extensive deposits of platiniferous alluvium would be found in the area. This, unfortunately, is not the case. The only considerable patches of alluvium are those along the Steelpoort. The largest of these is situated below the new road bridge across the Steelpoort. Its position is marked by a big alluvial terrace on which the original Fort Burger was situated. Sections exposed along the river show that the terrace is built up of some 20 feet of sandy loam, overlying an unknown thickness of fairly coarse gravel, composed almost entirely of rocks belonging to the norite zone. This gravel has been proved by Doctor Merensky to be platiniferous. During the coming winter months it is proposed to test it systematically. If the platinum contents of the gravel are at all consistent and not too low, this should prove a very fine dredging proposition.

Farther away east of the stream, on the farm Steelpoortsdrift No. 350, is an upper gravel terrace lying about 100 feet above the level of the river. This is made up mainly of big bowlders of quartzite and altered shale belonging to the Pretoria series. It apparently carries no platinum. Above the bridge over the Steelpoort, on the farms Leeuwvallei No. 183 and Steelpoortsdrift No. 350, is a smaller patch of alluvium. Here the thickness of the sandy overburden is only 8 feet. The underlying gravel has been proved at one point on Leeuwvallei No. 183 to be platiniferous. This patch is also to be tested as soon as possible. On the farm Sterkfontein No. 187, some miles farther upstream, there is a fairly big patch of high-level gravel on the south side of the Steelpoort. This is also said to carry platinum. On the farm Mooihoek No. 147 the Transvaal Consolidated Land & Development Co. has pegged a long strip of alluvium along a small water course draining the ridge in which the main chromite deposits on that farm are situated. The alluvium is stated to carry platinum, but no definite information concerning its platiniferous content is available. Patches of platiniferous alluvium have also been proved to exist along some of the other dry water courses of the area. About these the writer is not at present at liberty to say anything. Summarizing, it may be said, therefore, that the alluvial deposits of the area, while not very extensive, offer considerable possibilities.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES[1]

(MINE REPORT)

By J. P. Dunlop and F. Begeman

INTRODUCTION

The silver, copper, lead, and zinc mines of the Central States are in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from Appalachian system to the Rocky Mountain front, exclusive of the Black Hills. Most of the mines are in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

In the lead and zinc regions of the Central States the material sold is principally concentrates,[2] and payment is made according to a basic price for concentrates of a certain quality. The details of this method are given in the pages devoted to Missouri in this report for 1914. The figures reported by producers represent the quantity and assay contents of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

The operators in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted.

In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced but not smelted during the year has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF LEAD AND ZINC ORES OF THE CENTRAL STATES

Much of the ore mined in the Western States is crude smelting ore—that is, it can be smelted directly without preliminary concentration. All but a very small portion of the ore from the Central States, however, is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining

[1] A bibliography is given in Mineral Resources for 1919 and some preceding volumes.

[2] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore." Where the capacity of a concentrating plant is given, such capacity is to be understood as based on a 10-hour shift unless otherwise stated.

operations in different States is that of quantity of crude ore, or "dirt." In Kentucky and southern Illinois the lead and zinc concentrates are recovered as by-products in the concentration of the fluorspar which they accompany, and it is not possible to calculate the metal content of the crude ore raised.

Quantity and tenor of copper, lead, and zinc ores of Central States, 1922–1924

State	1922		1923		1924	
	Crude ore	Metal content [a]	Crude ore	Metal content [a]	Crude ore	Metal content [a]
	Short tons	*Per cent*	*Short tons*	*Per cent*	*Short tons*	*Per cent*
Arkansas	[b]		[b]		[b]	
Illinois (northern)	66,150	6.71	86,100	2.10	148,300	1.71
Kansas	2,151,200	4.00	2,680,700	4.26	3,215,000	4.09
Michigan	4,952,264	1.23	5,363,160	1.29	5,372,572	1.26
Missouri	5,879,700	3.40	6,098,900	3.16	6,518,800	3.30
Oklahoma	6,159,500	4.82	7,937,200	4.20	8,804,000	4.24
Wisconsin	221,000	3.90	454,000	3.34	652,000	2.97
	19,429,814		22,620,060		24,710,672	

[a] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper, in the other Central States the metals are lead and zinc, the relative proportions of which are shown in the table on another page and in the tables of tenor of ore given in the sections devoted to the respective States.

[b] No record of ore treated.

The marked increase in 1924 shown by this table was distributed mainly among the lead and zinc mines of Oklahoma and Kansas and the lead mines in southeastern Missouri. Smaller increases in the output of lead and zinc ores occurred in Wisconsin and Illinois. The output of disseminated lead ore in southeastern Missouri increased 744,800 tons.

The low average tenor of the crude ore mined in the Central States in 1924 is best shown by the fact that the average value of the total metal content was only $4.69 a ton of crude ore treated. This value was 7 cents less than in 1923, owing to the lower price of copper. The 19,338,100 tons of zinc, lead, and lead-zinc ores treated in the Central States exclusive of southern Illinois, Kentucky, and Arkansas in 1924 yielded lead and zinc concentrates that sold for $69,372,495, so that the mine operators realized an average of $3.59 a ton of ore mined and treated, against $3.42 a ton in 1923. The value of both lead and zinc concentrates was greater in 1924 than in 1923. The quantity of lead concentrates increased about 42,000 tons; the quantity of zinc concentrates increased about 61,000 tons.

PRODUCTION

GENERAL STATISTICS

The total value of the mine production of silver, copper, lead, and zinc in the Central States in 1924 was $7,974,722 more than the value for 1923. The total value for 1907 to 1924 was $1,725,692,488—$651,341,614 for zinc, $606,542,021 for copper, $461,174,632 for lead, and $6,634,221 for silver. The value of the zinc has been

much greater than that of the copper for the last six years, so that the total value of the zinc produced during the period is about $45,000,000 more than that of copper.

Mine production of silver, copper, lead, and zinc in the Central States in 1924, by States

State	Silver		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas					20	$3,200	4	$520	$3,720
Illinois	8,891	$5,957			1,464	234,240	2,512	326,560	566,757
Kansas					18,560	2,969,600	105,392	13,700,960	16,670,560
Kentucky					175	28,000	492	63,960	91,960
Michigan	130,381	87,355	135,662,605	$17,771,801					17,859,156
Missouri	103,694	69,475	182,811	23,948	189,929	30,388,640	12,920	1,679,600	32,161,663
Oklahoma					71,358	11,417,280	269,137	34,987,810	46,405,090
Wisconsin					1,254	200,640	14,027	1,823,510	2,024,150
	242,966	162,787	135,845,416	17,795,749	282,760	45,241,600	404,484	52,582,920	115,783,056
Total, 1923	409,437	335,738	138,506,636	20,360,476	256,438	35,901,320	376,550	51,210,800	107,808,334

Silver.—Nearly all the silver that has been produced in the Central States has been recovered incidentally in the production of other metals. The output in 1924 from the copper lodes of Michigan showed a decrease of 93,616 ounces, and that from the refining of lead bullion from Missouri decreased 73,576 ounces. The lead-zinc fluorspar deposits of the Kentucky-Illinois field also carry silver, and the silver recovered from the lead concentrates from Illinois was 8,891 ounces, an increase of 721 ounces.

Copper.—The mine production of copper in the Central States in 1924 came from Michigan and Missouri. Michigan, which, as in other years, contributed nearly all of the output, produced 2,641,475 pounds less than in 1923. The copper produced in Missouri was derived entirely from lead ores. The total mine production of copper from Michigan and Missouri in 1924 was about 138,000,000 pounds less than in 1916.

Lead.—The mine production of lead in the Central States in 1924 increased 10 per cent. Missouri produced 67 per cent of the yield, against 66 per cent in 1923, and the recoverable lead content of galena and lead carbonate concentrates mined in Missouri was equivalent to 33.5 per cent of the refined primary lead recovered in the United States from domestic ore. Of the total output of lead in Missouri the disseminated-lead district of southeastern Missouri produced 187,647 tons, again exceeding the Coeur d'Alene district of Idaho and retaining first place in the production of lead in the United States. Small shallow lead mines and barytes mines in southeastern Missouri reported the recovery of 90 tons of lead. Southwestern Missouri had an output of 2,192 tons, or 93 tons less than in 1923. The production in Oklahoma increased from 66,904 tons in 1923 to 71,358 tons in 1924. The production from Kansas mines increased from 17,598 tons in 1923 to 18,560 tons in 1924. Production in Illinois increased from 1,381 to 1,464 tons and in Wisconsin from 734 to 1,254 tons. The total production of lead from mines in the southern Illinois-Kentucky region, Arkansas, and the upper Mississippi Valley amounted to about 1 per cent of the output of the Central States.

Zinc.—The mine production of zinc in the Central States was 78 per cent of the total smelter output of primary zinc from domestic ores in the United States, against 74 per cent in 1923. Oklahoma produced 269,137 tons of zinc in 1924, against 242,421 tons in 1923. For many years, until 1917, Missouri had been the largest producer of zinc in the United States, but the output has decreased from 132,918 tons in 1917 to 12,920 tons in 1924. The production of zinc in Kansas rose from 56,225 tons in 1922 to 100,969 tons in 1923 and 105,392 tons in 1924. The Arkansas output decreased from 148 to 4 tons, Kentucky increased from 270 to 492 tons, and Illinois increased from 1,266 to 2,512 tons. No production of lead or zinc was reported from Iowa mines in 1924.

PRODUCTION OF LEAD AND ZINC BY REGIONS

The productive lead and zinc territory in the Central States naturally falls into seven regions, three of which are not limited to a single State. For statistical purposes the tables showing the production of lead and zinc by States are necessary, but for practical purposes it is desirable to show the production by the natural regions irrespective of State lines.

The seven regions, in order of size of output, are: (1) The Joplin region, comprising southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; (2) southeastern Missouri, containing the great deposits of disseminated lead; (3) the upper Mississippi Valley region, including all the lead and zinc mines in southwestern Wisconsin, Iowa, and northwestern Illinois; (4) the fluorspar region in southern Illinois and northern Kentucky; (5) northern Arkansas; (6) central Missouri; (7) the Arbuckle Mountain region, in southern Oklahoma.

The southeastern Missouri region produced 66.4 per cent of the lead output of the Central States and 33.1 per cent of the primary lead recovered from domestic ore smelted or refined in the United States in 1924. The Joplin region produced 32.6 per cent of the lead and 95.8 per cent of the zinc of the Central States in 1924 and was much the largest producer of zinc in the United States, yielding 75 per cent of the total zinc produced from domestic ores, as against 71 per cent in 1923.

The lower zinc content of the zinc concentrates produced at mines in the upper Mississippi Valley region is clearly indicated by the fact that, although these mines yielded nearly 8 per cent of the total output of raw zinc concentrates of all classes, the zinc content of such concentrates was only 3.9 per cent of the zinc from mines in the Central States.

The lead content of the galena concentrates shipped from the upper Mississippi Valley region averaged 72.6 per cent, that of the concentrates from the Joplin region averaged about 79 per cent, and that of the concentrates from the southeastern Missouri region averaged 67.6 per cent. A very small proportion of the galena shipped from the Joplin region contained more than 82 per cent. A large part of the sphalerite shipped from the Joplin region contained about 59 or 60 per cent of zinc, and the 45,410 tons shipped from the Waco district in that region averaged 61.2 per cent.

Mine production of lead and zinc in the Central States in 1924, by regions

Region	Lead [a]		Zinc [b]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin	118,770	$12,692,372	740,569	$30,626,421	$43,318,793
Southeastern Missouri [c]	292,604	24,739,819			24,739,819
Upper Mississippi Valley [d]	2,304	227,231	62,384	1,086,652	1,313,883
Kentucky-southern Illinois	1,937	162,505	3,146	88,135	250,640
Northern Arkansas	25	2,730	13	330	3,060
	415,640	37,824,657	806,112	31,801,538	69,626,195
Total, 1923	373,686	30,242,774	744,701	28,918,682	59,161,456
Metal:					
Joplin	92,110	14,737,600	387,449	50,368,370	65,105,970
Southeastern Missouri [c]	187,737	30,037,920			30,037,920
Upper Mississippi Valley [d]	1,639	262,240	15,670	2,037,100	2,299,340
Kentucky-southern Illinois	1,254	200,640	1,361	176,930	377,570
Northern Arkansas	20	3,200	4	520	3,720
	282,760	45,241,600	404,484	52,582,920	97,824,520
Total, 1923	256,438	35,901,320	376,550	51,210,800	87,112,120

[a] Includes both galena and a small quantity of lead carbonate concentrates.
[b] Includes sphalerite, zinc carbonate, and zinc silicate concentrates.
[c] Includes a small production from the central Missouri region.
[d] Includes Iowa, northern Illinois, and Wisconsin.

Mineral Resources for 1914 contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State for the period 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907.

ARKANSAS

By J. P. Dunlop

The value of the lead and zinc from Arkansas mines, which was $1,430,668 in 1917, was only $3,720 in 1924. The decrease in shipments was caused almost entirely by the low price and slow demand for zinc carbonate concentrates, which offered little encouragement to owners of old mines and did not invite the investment of new capital, which is needed to revive the industry. Very small amounts of milled zinc concentrates are produced in Arkansas, which militates against the sale of zinc ores because few smelters desire to purchase hand-cobbed zinc carbonate or sphalerite, as they are not equipped to crush the ore before placing it in the retorts.

The production of galena in Arkansas is small compared with that in other regions. The shipments of zinc carbonate and zinc silicate concentrates, 13 tons, were less than 1 per cent of the shipments in 1917.

Mine production of lead and zinc in Arkansas, 1907–1924 [a]

Year	Lead concentrates (galena)		Zinc concentrates				Metal content			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1907–1915	416	$22,348	8,576	$315,910	12,221	$506,842	331	$29,394	8,290	$1,365,538
1916	339	28,097	1,670	112,726	16,609	940,224	272	37,536	6,815	1,826,420
1917	474	47,593	916	57,824	17,053	650,585	382	65,704	6,691	1,364,964
1918	155	13,594	310	16,450	2,156	68,333	120	17,040	951	173,082
1919	35	2,400			510	18,170	28	2,968	189	27,594
1920	10	755			917	28,925	8	1,280	329	53,298
1921	27	1,510			42	580	21	1,890	15	1,500
1922	55	4,600			425	6,870	42	4,620	134	15,276
1923	32	2,559			444	9,919	25	3,500	148	20,128
1924	25	2,730			13	330	20	3,200	4	520

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921 to 1924. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Arkansas, 1921–1924

	1921	1922	1923	1924
Total crude ore, short tons				[a]
Average lead content of galena concentrates, per cent	77.7	78.2	78.1	80.0
Average zinc content of zinc silicate and carbonate, do	40.0	36.0	37.8	
Average value per ton:				
Galena concentrates	$55.93	$72.73	$79.97	$109.20
Zinc silicate and carbonate	$13.81	$16.16	$22.34	$25.38

[a] The quantity of ore mined was very small, and very little of it was milled, so that no calculations as to tenor are available; part of the ore sold was taken from stock in bins.

The mines are principally in Boone and Marion Counties and the adjoining portions of Searcy and Newton Counties, though there are numerous prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and deposits have been worked in Washington and Sevier Counties, on the extreme western border of the State.

The ores are galena, sphalerite, and smithsonite, and the concentrates produced are generally of high grade and free or nearly free from iron or lime. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, especially in a yellow variety of smithsonite known locally as "turkey fat," which shows as much as 0.8 per cent of cadmium.

Few of the lead and zinc mines of Arkansas were operated in 1924, and none of those from which concentrates were shipped were operated steadily. Shipments of lead and zinc ores in 1924 came from four small mines, and the value of the concentrates shipped decreased from $12,478 in 1923 to $3,060 in 1924.

The Mattie May mine, at Rush, Marion County, produced all the zinc carbonate.

The only shipments of galena concentrates from Marion County in 1924 were made by B. Lawhorn and Joe Hampton, and most of the galena was shipped by Brewer & McFerren from the Ponca dis-

trict, in Newton County. Some of the land near Ponca is being prospected by the Eagle Picher Lead Co. No shipments were reported by the lessees of the American Zinc, Lead & Smelting Co.'s land in Newton County, though some development was done and a 100-ton mill was under construction at the Bald Hill mine. There was a renewal of operations in the Zinc and Dodd City districts late in the year, several old mines having been reopened.

A shaft was sunk by Doctor Cotton near Camp Pike in Pike County to a depth of 900 feet, several thousand feet of drifts run, and a 75-ton flotation plant built. The ore is in shale pockets and contains galena and sphalerite. Some lead concentrates averaging 65 per cent lead and 65 ounces of silver were shipped in 1924; the zinc concentrates were not sold in that year.

ILLINOIS

By J. P. Dunlop

PRODUCTION

Mine production of lead and zinc in Illinois in 1924, by districts [a]

District	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [b]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Northern Illinois	552	$51,846	7,000	$112,468	385	$61,600	1,643	$213,590
Southern Illinois	1,678	139,597	1,652	51,135	1,079	172,640	869	112,970
	2,230	191,443	8,652	163,603	1,464	234,240	2,512	326,560
Total, 1923	2,069	157,162	4,863	77,740	1,381	193,340	1,266	172,176

[a] Mineral Resources for 1914 contains a historical review of lead and zinc mining in Illinois.

[b] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Illinois, 1921–1924

	1921	1922	1923	1924
Northern Illinois				
Total crude ore, short tons	81,400	66,150	86,100	148,300
Total concentrates in crude ore:				
Lead, per cent	0.85	1.18	0.35	0.38
Zinc, do	9.46	12.55	5.54	4.72
Metal content of crude ore:				
Lead, do	.66	.88	.25	.26
Zinc, do	3.44	5.83	1.85	1.45
Average lead content of galena concentrates, do	77.8	74.2	71.0	71.2
Average zinc content of sphalerite concentrates, do	36.4	40.6	33.4	30.7
Average value per ton:				
Galena concentrates	$53.84	$64.48	$77.54	$93.92
Sphalerite concentrates	$12.57	$19.98	$15.77	$16.07
Southern Illinois				
Average lead content of galena concentrates, per cent	78.0	70.2	67.6	65.6
Average zinc content of sphalerite concentrates, do				59.77
Average value per ton of galena concentrates	$60.18	$69.69	$75.68	$83.19

Mine production of silver in southern Illinois, 1907–1924

Year	Silver		Lead concentrates, silver bearing		Year	Silver		Lead concentrates, silver bearing	
	Fine ounces	Value	Short tons	Ounces of silver per ton		Fine ounces	Value	Short tons	Ounces of silver per ton
1907–1915	25,220	$14,371	4,199	6.00	1920	8,193	$8,930	1,252	6.55
1916	5,684	3,740	874	6.50	1921	1,345	1,345	181	7.43
1917	7,186	5,921	1,239	5.80	1922	6,025	6,025	1,100	5.48
1918	8,171	8,171	1,228	6.65	1923	8,170	6,699	1,762	4.64
1919	4,440	4,973	715	6.16	1924	8,891	5,957	1,678	5.30

The value of the mine production of silver, lead, and zinc in Illinois in 1924 was $566,757, as compared with $372,215 in 1923. The increase was due mainly to the larger quantity of zinc shipped. Silver increased in quantity but decreased in value.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineral associations and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwestern county of the State. The ores are galena, smithsonite, and sphalerite, though the first two are much less common now than formerly, when most of the deposits worked were shallow and above water level.

The entire output of northern Illinois is included under the Galena district, which comprises the mines from the vicinity of Fever River to the Wisconsin State line.

A large increase in quantity of crude ore and considerable increases in concentrates are shown in the accompanying tables. The percentage of zinc concentrates recovered decreased, as did also the percentage of zinc content in the crude ore. Most of the lead and zinc concentrates came from the Black Jack mine of the Mineral Point Zinc Co., which was reopened in 1923.

There was some output of lead and zinc from the North Unity mine before it was abandoned as worked out by the Vinegar Hill Zinc Co.

Tailings were milled by Thomas Kollman and by A. Hollander. There was less mining and prospecting by small operators than in former years, and no new properties of any importance were discovered.

SOUTHERN ILLINOIS

The lead and zinc deposits of southern Illinois are found in Pope and Hardin Counties in rocks of Mississippian age in the northern extension of the Kentucky-Illinois fluorspar district. The principal product of the mines in recent years has been fluorspar, and the yield of galena is small compared with the output from other districts in the Central States.

The total production of galena concentrates in southern Illinois from 1906 to 1924 has been 14,431 tons, most of which has been shipped from the Fairview, Rosiclare, and Hillside mines. The shipments of zinc ores from the district have been comparatively small and scattered. The only recorded shipments of zinc carbonate, aggregating 103 tons, were made from the Empire mine in 1903 or 1904 and from four companies in 1906.

Formerly large bodies of galena near the surface were worked, but galena is now produced incidentally in the concentration of the fluorspar. For this reason it would be misleading to give the quantity of crude ore. The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, and the silver content averaged between 4.64 and 7.5 ounces to the ton of lead concentrate for the last nine years.

Sphalerite, or zinc blende, occurs much less plentifully than galena, and the first large shipments of sphalerite in many years were made in 1924 from the new 250-ton plant of the Fairview Fluorspar & Lead Co. The sphalerite shipped had an average zinc content of 59.77 per cent.

The shipments of galena concentrates decreased from 1,762 tons in 1923 to 1,678 tons in 1924, and the silver recovered in treating the concentrates increased from 8,170 to 8,891 ounces, owing to the larger recovery per ton from the galena of the Fairview mines.

The Fairview Fluorspar & Lead Co. operated the Good Hope vein, which was first developed in 1862. Three shafts were operated at levels between 50 and 400 feet in 1924. The Fairview mines at Rosiclare were sold in November, 1924, to the Franklin Fluorspar Co., a subsidiary of the Aluminum Co. of America.

The Rosiclare Lead & Fluorspar Mining Co. mill is designed to handle 500 tons a day and is provided with special facilities for saving the lead and zinc, both by jigs and tables. The Hillside Fluor Spar Mines' mine and concentrating plant near Rosiclare was operated in 1924. The shaft is 350 feet deep, and the milling plant has a capacity of 200 tons (eight-hour shift). The galena concentrate, assaying 67 per cent lead and about 4.5 ounces of silver a ton, was shipped to the St. Louis plant of the National Lead Co.

IOWA

The lead and zinc deposits of Iowa extend along the Mississippi River for nearly 80 miles, in Dubuque, Clayton, and Allamakee Counties. No shipments of lead or zinc concentrates from mines in Iowa have been reported since 1918.

KANSAS

By J. P. Dunlop

Mine production of lead and zinc in Kansas in 1924, by districts[a]

District	Lead concentrates[b]		Zinc concentrates		Metal content			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Badger-Peacock-Crestline	1,681	$180,478	409	$13,256	1,320	$211,200	185	$24,050
Blue Mound-Baxter Springs	21,481	2,340,997	174,581	7,374,211	16,716	2,674,560	91,936	11,951,680
Galena	492	47,814	39	1,307	353	56,480	16	2,080
Waco (in Kansas)	234	23,996	24,598	1,099,679	171	27,360	13,255	1,723,150
	23,888	2,593,285	199,627	8,488,453	18,560	2,969,600	105,392	13,700,960
Total, 1923	22,613	2,187,892	190,454	7,763,314	17,598	2,463,720	100,969	13,731,784

[a] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, while the value of the lead and zinc is calculated from the average price for all grades.

[b] Includes 113 tons of lead carbonate from Galena, averaging 62.8 per cent of lead.

Tenor of lead and zinc ore and concentrates produced in Kansas, 1922–1924

	1922	1923	1924
Total crude ore, short tons	2,151,200	2,680,700	3,215,000
Total concentrates in crude ore:			
Lead, per cent	1.37	0.84	0.74
Zinc, do	4.85	5.98	5.84
Metal content of crude ore:			
Lead, do	1.10	.67	.59
Zinc, do	2.90	3.59	3.50
Average lead content of galena concentrates, do	80.6	79.4	79.4
Average zinc content of sphalerite concentrates, do	59.9	60.0	60.0
Average value per ton:			
Galena concentrates	$78.14	$96.78	$108.70
Sphalerite concentrates	$33.56	$40.76	$42.52

The lead and zinc deposits of Kansas, so far as developed, are limited to Cherokee County, in the southeastern part of the State. They form the western extension of the ore deposits of the Joplin region and display the general characteristics shown in that region, except that here typical sheet-ground deposits have not been extensively developed.

It is difficult to ascertain the production for early years or to segregate the Kansas ores from those produced in the Missouri portion of the Joplin region. If to the figures for 1886 to 1903, published by the Kansas Geological Survey,[3] are added those for 1904 to 1924, published in Mineral Resources of the United States, a total of 1,904,080 tons of zinc concentrates and 295,922 tons of lead concentrates is shown as the approximate production of Kansas

[3] Haworth, Erasmus, and others. History, geography, and metallurgy of Galena-Joplin lead and zinc. Kansas Univ. Geol. Survey, vol. 8, 1904.

for 1886 to 1924. About 60 mines, of which 44 are in the Blue Mound-Baxter area, shipped lead or zinc in 1924.

The older mining camps at Lawton and Badger-Peacock produced very little zinc and lead in 1924, and nearly all the production from Kansas came from the Blue Mound-Baxter district, an extension of the Miami field, and the Waco camp, on the Kansas-Missouri State line. The Crestline district was still being unwatered, and the output, though larger than in 1923, was comparatively small. Several new mills are ready for operation and will probably produce in 1925.

The zinc content of the sphalerite from the Waco district was about 61.2 per cent and that from the Blue Mound-Baxter district about 60 per cent.

Badger-Peacock-Crestline district.—The production in the Badger-Peacock-Crestline district, including shipments of galena and sphalerite from mines west of Badger, was 1,681 tons of galena and 409 tons of sphalerite, against 400 tons of galena and 86 tons of sphalerite in 1923. The Jackson mine, on the Chanute Spelter Co.'s lease, was operated by Andrew Bros. The Kanok Mining Co.'s mill (200 tons) was not operated.

The Ellis and Crutchfield mills and mines of the Eagle Picher Lead Co. had some output of lead and zinc, but the work done was mainly development and pumping. The water level has receded so much that a large output is expected in 1925 from this property and from adjoining leases.

The Underwriters Land Co. finished and operated a 300-ton mill which produced mainly galena. Most of the land adjacent to the present mining area has been leased, and drilling was done by the Kansas Exploration Co. and other large operators. The Crestline Products & Service Co. completed a 150-ton mill and a 150-foot shaft and was sinking a 175-foot shaft. This new plant will not operate until 1925. Burton & Detchmondy also sunk a shaft which disclosed a good body of lead ore.

Lawton-Waco district.—The output of the Lawton-Waco district came from the mines near Waco, as the one producing property at Lawton—that of the Eastern Lead & Zinc Co.—was idle, though the lease was under a drilling option. The total output of the Waco district, lying partly in Missouri and partly in Kansas, was 45,410 tons of sphalerite and 423 tons of galena, against 47,030 tons of sphalerite and 175 tons of galena in 1923. The production of the Kansas portion of the district was 24,598 tons of sphalerite and 234 tons of galena, as compared with 19,934 tons of sphalerite and 36 tons of galena in 1923. The principal producing properties in the Kansas part of the district were the Butte Kansas and the Acme mines, which were operated most of the year. Four shafts were operated at the two mines in ore at 125 to 285 feet. One mill has a capacity of 500 tons a shift and the other of 150 tons a shift. Two new shafts were sunk at the Acme. Barnsdall No. 3 had a large production. Three shafts were used to hoist ore for the 500-ton mill. Freehold No. 3, the only other producing mine on the Kansas side, was operated by sublessees, known as At Last Mining Co. Barnsdall No. 1, which has been idle for several years, has been transferred to the Grasselli Chemical Co., and the mine is being unwatered, the mill rebuilt, and the lease drilled.

Galena district.—The production of lead concentrates in the Galena district was 379 tons of galena and 113 tons of lead carbonate, as compared with 128 tons of galena and 26 tons of lead carbonate in 1923. There were small shipments of sphalerite concentrates derived from old dumps cleaned at chat mills and at the sludge plant of C. W. Squires. The galena was derived from clean-ups or from shallow mining, as the mines in this field are flooded and no pumping was done in the years 1922 to 1924.

If the price of ore remains at the level reached at the end of 1924 the mines at Galena will probably be unwatered and mining resumed, for the crude ore contains considerable galena. Concerted effort is necessary, however, for most of the mines are connected underground and the lease owners and mine operators have not enough capital or ore in sight to undertake the unwatering of the large area of cut ground.

Blue Mound-Baxter Springs district.—There was considerable activity in that part of Cherokee County south and west of Baxter Springs and north of the Oklahoma State line. The Eagle Picher Lead Co., Kansas Exploration Co., Federal Mining & Smelting Co., Black Eagle Mining Co., Underwriters Land Co., and Commerce Mining & Royalty Co. explored with drills a large part of the territory northwest and northeast of Picher. An effort is being made to block out by drilling the ore bodies, lying at unusually low levels, which have been located north and west of present proved and operated areas. New shafts were sunk, several new mills were erected, and a number of properties changed hands.

Most of the output in 1924, as in 1923, came from mines north and northwest of the Picher area and close to the State line, and mines north of Hockerville and east and north of Blue Mound produced 521 tons more lead than in 1923, but shipped 7,360 tons less sphalerite concentrates in 1924 than in 1923.

The shipments of concentrates from the Blue Mound-Baxter area, which in 1923 amounted to 22,023 tons of galena and 169,945 tons of sphalerite, were 21,481 tons of galena and 174,581 tons of sphalerite. The average lead content of the galena sold was 79.4 per cent, and the zinc content of the sphalerite concentrates sold was 60 per cent. The crude ore ("dirt") milled yielded 6.95 per cent in concentrates, and at some mines the recovery was more than 10 per cent. Of the total shipments 84 per cent came from mines west and northwest of Blue Mound, which shipped 79 per cent in 1923. About 88 per cent of the lead shipped from the district came from mines west and northwest of Blue Mound. The sales of zinc concentrates were larger than the production, and the large stock of sphalerite in bins at mines near Blue Mound was nearly all sold and shipped in 1924.

The producing properties in the area west and northwest of Blue Mound were the State Line Zinc Co. (Blue Diamond), Clark Milling Co. (Blue Diamond tailings), Vinegar Hill (Barr), Webber, West Side, Early Bird, Southern, Tar Creek (old Tampa), Childress (Wade), Chubb, Tulsa Quapaw, Cherokee, Lucky Jew mine of Eagle Picher, Black Eagle No. 2, Kansouri (Federal), Fox, Bendelari, Big Elk, Lawyers, Boska (Redskin), King Brand, and Muncie (Childress). The producing properties north of Hockerville and Zincville and east and north of Blue Mound were the Hartley, Brewster, Ebenstein (Chanute Spelter Co.), Commonwealth No. 2, Cherokee, Euterpe,

Sunshine, Empire, Homestake, Baxter, Brugger (now Vantage No. 3), and Queen Esther (now Peru Mining Co.).

New concentrating plants were erected by the Northern Mining Co. (old Crescent) (150 tons), Vantage Mining Co. No. 3 (200 tons), Euterpe Mining Co. (300 tons), Grace B. Mining Co. (250 tons), Wilbur (Commerce Mining & Royalty Co.) (300 tons), Cortez King Brand Mining Co. (Liza Jane mine) (250 tons), and Golden Rod Mining & Smelting Co. No. 21 (200 tons).

The Barr, West Side, Webber, Southern, King Brand, Kansas Exploration, Big Elk, Brugger, Blue Diamond, Southern, Lawyers, Black Eagle, Muncie, Chubb, Tulsa Quapaw, and Early Bird mines each shipped more than 500 tons of galena in 1924. The mines that shipped more than 3,000 tons of sphalerite in 1924 were the Barr, West Side, Webber, Southern, Wade, King Brand, Boska (Redskin), Lucky Jew, Queen Esther, Black Eagle, Cherokee, Chubb, Brewster, Muncie, Lawyers, Bendelari, Early Bird, Homestake, Kansas Exploration, Kansouri (Federal), Jarrett, and Tulsa Quapaw.

The old Hartley mine was taken over by the S. R. W. Mining Co., the Brewster by the Barnsdall Zinc Co., the East Side by the Golden Rod Mining & Smelting Co., the Wade by the Childress Lead & Zinc Co., the Lucky Jew by the Eagle Picher Lead Co., the Brugger by the Vantage Mining Co., the Lucky OK by the Sunshine Mining Co., the Queen Esther by the Peru Mining Co., the Meese by the Cherokee Development Co., the Kansas Line by J. S. Mabon, and the Crescent by the Northern Mining Co. The Eagle Picher Lead Co., the Commerce Mining & Royalty Co., and the Golden Rod Mining & Smelting Co. sank some new shafts in 1923 and have some leases ready for mills when they require new producing mines.

New mills were being erected by the Northern Mining Co., Cortez King Brand Mining Co. (Liza Jane mine), and Barnsdall Zinc Co.

The Redskin mine, which was operated by trustees of creditors until the debts were paid, has reverted to the Boska Mining Co.

The Euterpe mill, which was destroyed by fire twice in two years, has been rebuilt.

KENTUCKY

By J. P. Dunlop

Lead and zinc deposits are found in both central and western Kentucky. None of the mines in the central districts reported any lead or zinc concentrates shipped in 1924. The deposits in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingston Counties, and form a continuation of those in the southern Illinois lead and zinc region.

Considerable quantities of galena ores have been produced in former years, but at present lead is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, the silver content ranging from a very small quantity to more than 3 ounces a ton, but no recovery of this silver content has been reported by the smelters during the last 13 years.

Mine production of lead and zinc in Kentucky, 1907–1924

Year	Lead concentrates (galena)		Zinc concentrates				Metal content			
			Sphalerite		Zinc carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1907–1915	709	$31,602	723	$31,717	4,909	$160,669	480	$44,390	2,040	$342,886
1916	227	16,868	125	6,407	2,923	126,875	153	21,114	1,096	293,728
1917	184	15,415	------	------	2,299	78,368	123	21,156	751	153,204
1918	255	21,066	------	------	927	30,390	185	26,270	315	57,330
1919	120	7,250	------	------	120	3,600	86	9,116	36	5,256
1920	172	12,295	------	------	25	750	122	19,520	9	1,458
1921	100	3,693	------	------	621	19,800	69	6,210	220	22,000
1922	132	8,365	------	------	419	8,373	92	10,120	142	16,188
1923	78	6,152	------	------	850	17,925	53	7,420	270	36,720
1924	259	22,908	------	------	1,494	37,000	175	28,000	492	63,960

The average lead content of galena concentrates in 1924 was 69.1 per cent. The total value of the lead and zinc concentrates shipped from Kentucky mines was $59,908, against $24,077 in 1923.

The principal sellers of galena concentrates were the Kentucky Fluorspar Co. and the Keystone Fluorspar & Lead Co. The Zinc & Spar Co. operated the Hudson mine, near Salem, Livingston County. The zinc carbonate ore was taken from workings about 85 feet in depth and treated in log washers and by jigs and tables before shipment.

MICHIGAN

By F. Begeman

PRODUCTION

The smelter output of refined copper in Michigan in 1924 was 145,333,227 pounds, as compared with 137,691,306 pounds in 1923. The difference between the mine and the smelter production is due to the fact that the quantity of concentrates or "mineral" produced is not the same as the quantity smelted. A company may produce either more or less "mineral" than it smelts during the year.

Mine production of silver and copper in Michigan, 1923–24 [a]

Year	Silver (fine ounces)	Copper			Concentrate ("mineral")		Ore ("rock") (short tons)
		Pounds	Yield		Pounds	Yield (per cent)	
			Pounds per ton of ore ("rock")	Percentage			
1923	223,997	[b] 138,304,080	25.8	1.29	[c] 220,055,091	62.8	[d] 5,363,160
1924	130,381	[b] 135,662,605	25.3	1.26	[c] 213,779,365	63.5	[d] 5,372,572
Increase or decrease	−93,616	−2,641,475	−.5	------	−6,275,726	------	+9,412

[a] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during the year.
[b] Includes copper from sands.
[c] Includes "mineral" from sands.
[d] Includes sands.

Value of silver and copper produced in Michigan mines, 1923–24

Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")	
1923	$183,678	$20,330,700	$3.79	$20,514,378
1924	87,355	17,771,801	3.31	17,859,156

MISSOURI

By J. P. Dunlop

PRODUCTION

The value of the mine production of silver, copper, lead, and zinc in Missouri in 1924 was $32,161,663, compared with $26,423,197 in 1923. The value of copper decreased $5,828, that of zinc $804,440, and that of silver $75,886. The value of lead increased $6,624,620. The lead content of Missouri lead concentrates sold in 1924 was equivalent to 33.5 per cent of the smelter production of primary lead in the United States derived from domestic ores, against 31 per cent in 1923; and the zinc content of Missouri zinc concentrates sold in 1924 was 2.5 per cent of the primary zinc produced by smelters from domestic ores in 1924, as against 3.6 per cent in 1923 and 22.7 per cent in 1917. About 95 mines and prospects in Missouri shipped lead or zinc concentrates in 1924.

Mine production of copper and silver in Missouri, 1910–1924

Year	Copper		Silver		Lead concentrates, silver bearing (short tons)
	Pounds	Value	Fine ounces	Value	
1910–1918	3,527,293	$667,666	510,920	$333,582	495,823
1919	1,617,200	300,799	[a]90,401	101,249	81,000
1920	1,512,539	278,307	[b]111,128	121,130	90,000
1921	137,591	17,749	69,902	69,902	44,000
1922	797,400	107,649	212,656	212,656	138,000
1923	202,556	29,776	177,270	145,361	118,000
1924	182,811	23,948	103,694	69,475	90,000

[a] Includes 29,480 ounces of silver from cobalt-nickel-copper ore.
[b] Includes 28,664 ounces of silver from cobalt-nickel-copper ore.

The silver content of the lead ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied on for the silver production. As may be seen by inspection of the table, the quantity of silver produced in any year bears no direct ratio to the quantity of lead concentrates smelted during that year, because the silver content is so small that the silver bullion is stored and refined in batches. Over a series of

years the concentrates average more than 1 ounce of silver to the ton.

None of the copper mines in Missouri shipped any ore in 1924. The copper was derived from matte recovered in smelting lead ore mined in St. Francois County, in southeastern Missouri.

The value of the metallic content of the lead and zinc concentrates produced in Missouri in 1924 was $32,068,240, an increase of $5,820,180 over that of 1923. The production of lead concentrates (of which all but 282 tons was galena) was 295,604 short tons, as compared with 262,442 tons in 1923. Of the output in 1924, 292,604 tons was derived from southeastern and central Missouri, an increase of 33,284 tons. The average metal content of the lead concentrates from these districts was 67.6 per cent, as compared with 65.9 per cent in 1923, and the value per ton in 1924 was $84.55 as compared with $74.94 in 1923. The quantity of lead in southeastern and central Missouri concentrates in 1924 amounted to 187,737 tons, an increase of 20,279 tons.

Shipments of galena concentrates from southwestern Missouri were 2,718 tons, compared with 2,926 tons in 1923. The lead carbonate concentrates amounted to 282 tons, an increase of 86 tons. The quantity of lead from southwestern Missouri, or the Missouri portion of the Joplin region, was 2,192 tons, a decrease of 93 tons. The average metal content of the galena concentrates from southwestern Missouri was 76.1 per cent, and the average value per ton was $101.31, or $17.91 more than in 1923.

The quantity of zinc blende concentrates sold from Missouri mines was 23,261 tons, a decrease of 8,895 tons compared with 1923. All the blende concentrate was produced in southwestern Missouri. The average value received was $41.91 a ton, and the average zinc content reported by the sellers was 60.7 per cent, compared with $40.52 and 60.2 per cent in 1923.

The zinc carbonate and silicate concentrates sold amounted to 1,453 tons, or 2,321 tons less than in 1923. The output came entirely from southwestern Missouri. The average metal content of the zinc carbonate and silicate concentrates was 39.3 per cent, and the average value per ton was $24.29, compared with $26.57 in 1923.

The value of lead concentrates from southeastern and central Missouri (which produced about 99 per cent of the lead concentrates) was $24,739,819, or $5,305,186 more than in 1923. The total value of the lead and zinc concentrates from southwestern Missouri was $1,307,620, compared with $1,661,050 in 1923.

The total quantity of crude ore or "dirt" mined and treated in Missouri in 1924 was 6,518,800 short tons. As the total amount received for all classes of lead and zinc concentrates sold in 1924 was $26,047,439, the average value per ton of crude ore or "dirt" mined and treated was $4.

In the following tables, showing the tenor of crude ore ("dirt") and concentrates from Missouri, it has been considered advisable to segregate the ores of different nature. The disseminated lead ore of southeastern Missouri differs radically from the lead and zinc ores of the so-called "soft ground" deposits of southwestern Missouri. Each class of ore has its peculiar problems of mining and ore dressing. The data are given for the ores mined in the Joplin region, but as the

recoveries from "sheet ground" were very small in 1920 and 1921 and there were none in 1922, 1923, and 1924, it was not possible to differentiate between the "soft ground" and "sheet ground" recoveries. In general, the tables reflect very closely the conditions of the industry.

The much higher percentage of concentrates recovered from crude ore treated in 1924 was due mainly to the closing of the big mill that treated low-grade ore mined from the open cut at the Oronogo Circle mine, at Oronogo.

Mine production of lead and zinc in Missouri, 1924, by districts

District	Lead concentrates				Zinc concentrates			
	Galena		Carbonate		Sphalerite		Silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alba-Neck City					69	$2,572		
Aurora					8	320	23	$600
Carthage					445	15,889		
Duenweg-Porto Rico	11	$1,100			152	4,344	9	260
Granby	336	29,192			154	5,572	1,006	24,084
Joplin	1,391	144,862	165	$13,200	852	32,834	330	8,447
Oronogo	260	25,374			164	6,630	35	653
Spring City-Spurgeon-Seneca	215	20,119	115	8,852			50	1,250
Springfield					156	6,240		
Stark City	14	1,360	2	144				
Waco (in Missouri)	189	19,956			20,812	886,993		
Webb City-Carterville-Prosperity	285	31,375			449	13,369		
Christian County	17	2,027						
Southeastern Missouri	2,718 292,604	275,365 24,739,819	282	22,196	23,261	974,765	1,453	35,294
Total, 1923	295,322 262,246	25,015,184 19,678,678	282 196	22,196 13,640	23,261 32,156	974,765 1,303,093	1,453 3,774	35,294 100,272

District	Metal content*			
	Lead		Zinc	
	Short tons	Value	Short tons	Value
Alba-Neck City			34	$4,420
Aurora			12	1,560
Carthage			232	30,160
Duenweg-Porto Rico	9	$1,440	70	9,100
Granby	257	41,120	429	55,770
Joplin	1,092	174,720	526	68,380
Oronogo	175	28,000	90	11,700
Spring City-Spurgeon-Seneca	233	37,280	17	2,210
Springfield			82	10,660
Stark City	12	1,920		
Waco (in Missouri)	185	29,600	11,224	1,459,120
Webb City-Carterville-Prosperity	216	34,560	204	26,520
Christian County	13	2,080		
Southeastern Missouri	2,192 187,737	350,720 30,037,920	12,920	1,679,600
Total, 1923	189,929 169,743	30,388,640 23,764,020	12,920 18,265	1,679,600 2,484,040

* In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of crude lead and zinc ore and concentrates produced in southwestern Missouri, 1922–1924

	1922	1923	1924
Total crude ore.....short tons	727,300	784,000	459,100
Total concentrates in crude ore:			
Lead.....per cent	0.31	0.4	0.65
Zinc.....do	4.24	4.58	5.38
Metal content of crude ore:			
Lead.....do	.23	.3	.49
Zinc.....do	2.47	2.65	3.20
Average lead content of galena concentrates.....do	75.7	75.6	76.1
Average lead content of lead carbonate concentrates.....do	56.1	60.2	60.0
Average zinc content of sphalerite concentrates.....do	60.3	60.0	60.7
Average zinc content of silicates and carbonates.....do	39.2	38.6	39.3
Average value per ton:			
Galena concentrates	$69.44	$83.40	$101.31
Lead carbonate concentrates	56.36	69.60	78.71
Sphalerite concentrates	31.91	40.52	41.91
Zinc silicates and carbonates	21.25	26.57	24.29

Tenor of crude lead ore and concentrates in southeastern Missouri disseminated-lead district, 1922–1924

	1922	1923	1924
Total crude lead ore.....short tons	5,152,400	5,314,900	6,059,700
Galena concentrates in crude ore.....per cent	5.26	4.88	4.83
Lead content of crude ore.....do	3.50	3.21	3.26
Average lead content of galena concentrates.....do	66.5	65.9	67.6
Average value per ton of galena concentrates	$54.48	$74.94	$84.55

Mineral Resources for 1914, Part I, pages 72 to 77 and 97 to 100, gave a brief history of lead and zinc mining in the southeastern Missouri and Joplin regions, with data relating to the total lead and zinc production, the mining and milling practice, the character of the ore and concentrates, and the methods of selling them.

SOUTHWESTERN MISSOURI

AREA AND PRODUCTION

The southwestern Missouri lead and zinc areas include the largest part of the Joplin region, the remainder lying in southeastern Kansas and northeastern Oklahoma.

Lead and zinc concentrates produced in the Missouri part of the Joplin region, 1907–1924

	Short tons	Value	
		Total	Average
Lead concentrates	446,877	$28,471,046	$63.71
Sphalerite concentrates	2,798,873	142,497,841	50.91
Zinc carbonate and silicate concentrates	296,508	9,174,107	30.94
	3,542,258	180,142,994	

PRICES

The following quoted base prices apply not only to southwestern Missouri, but also to all the mines in Oklahoma and Kansas that are in the Joplin region. The average quoted base prices for 60 per cent sphalerite were highest during December, 1924. The prices were $43 to $44 a ton in January, $44 and $45 the middle part of February, and $40 to $41 in March. Early in April prices dropped to $38, then advanced to $39, a price that held steady until early in July. Prices increased to $43 about the middle of August. In the last week of September prices declined to $41. There was a steady advance from the middle of October until the end of the year. The October prices were $43 to $45, the November prices $45 to $48, and the December prices $48 to $57.50, being highest the last week in 1924.

Base prices for calamine or zinc silicate ores were seldom quoted during 1924, though the demand was better. The output was only about one-third as much as in 1923 and was produced by many operators. Nearly all the production was from Granby and near Joplin and was sold by the mines in small lots, which partly accounts for the lower price.

The quoted price for galena carrying 80 per cent of lead showed wide variations. In December it was $125 to $135 a ton, in May $77.50 to $80. The price for galena was unsteady at $107.50 to $117.50 a ton during January. In February it advanced to $125 a ton and remained steady until the middle of March, when it declined rapidly, reaching $105 early in April. The decline was resumed late in April and in May, reaching the lowest price of the year the third week in May. The price remained steady at $80 until the middle of July, advancing at that time to $86 and again to $92 on August 1, where it remained until October 10, except for a slight dip in September. The price advanced to $120 in November, then to $125 early in December. The prices in the last two weeks of December were $130 to $135.

Average prices per ton paid for sphalerite and zinc and lead concentrates in southwestern Missouri, 1917–1924

	1917	1918	1919	1920	1921	1922	1923	1924
Sphalerite	$71.04	$51.27	$40.67	$45.79	$25.18	$31.91	$40.52	$41.91
Zinc silicate or carbonate concentrates	40.50	32.27	27.30	35.50	10.57	21.25	26.57	24.29
Galena concentrates	101.90	89.92	66.82	97.84	50.15	69.44	83.40	101.31

These prices are not averages of base-price quotations but averages calculated from the quantity sold and the amounts received as reported by the sellers.

GENERAL CONDITIONS

Although prices for lead and zinc concentrates were higher than in 1923, there was no increase in the total mine output from the Missouri part of the Joplin region. There was some development of "sheet ground" near Pierce City, though no ore was milled in 1924. There was, however, a greatly increased amount of drilling in Missouri by large operators, which will result in the opening of new mines.

The Missouri portion of the Waco district produced about 90 per cent of the entire output of sphalerite shipped from southwestern Missouri in 1924. The mines at Waco, in Missouri only, that contributed the 20,812 tons of sphalerite and 189 tons of galena were those of the Barnsdall Zinc Mining Co., Allegheny Western Mining Co., American Zinc, Lead & Smelting Co., Tulsa-Pittsburg Mining Co., Freehold Oil & Gas Co., and Pyramid Mining Co. No concentrates were sold from any mines in the Sarcoxie-Reeds, Alba, Wentworth, and Cave Springs districts, and the zinc concentrates shipped from Aurora and Springfield were taken from stock piles, as no production was made in 1924.

There was considerably more prospecting in 1924 than in 1923, especially during the fall. A demand for zinc carbonate and silicate at fair prices caused the reopening of some old mines and prospecting for new ones in the Granby, Spurgeon, Racine, and Joplin districts, and 1,453 tons of zinc silicate and carbonate were shipped. The higher prices for galena and sphalerite resulted in a number of drills being operated in the older camps and an extensive drilling campaign in the area lying between Oronogo, Alba, and Neck City and the productive mines at Waco, and also in the old Smithfield, Thoms Station, and Carthage areas. Two new plants under construction in 1924 but not operated until early in 1925 were the Kansas Exploration Co., near Smithfield, and the Eagle Picher Lead Co. mill at Bryceville, near Pierce City. The latter has an incline shaft to "sheet ground" formation at a shallow level, so that loaded mine cars can be hauled directly from the working face of the ore to the mill.

The production in the Neck City, Spring City, Stark City, Duenweg, Webb City-Carterville, and Spurgeon districts was scattered and small. The only active property at Carthage was that of the Lucky Eleven Mining Co., and most of the sphalerite concentrates from Duenweg came from a tailing mill on Boston Duenweg land. Much of the output at Spurgeon was galena from the Red Rooster mine on the American Zinc, Lead & Smelting Co.'s land. Some old mines near Thoms Station were being reopened, but the only producer in 1924 was the Billy B 150-ton mill, which was started late in 1924.

The large Oronogo Circle plant was dismantled and mine operations were suspended. The property was leased and a smaller mill built to handle the higher-grade dirt mined by lessees from the old stopes and not from the lower-grade ore in the open cut. No large plants were operated steadily near Joplin, but a number of small operators shipped 1,391 tons of galena, 165 tons of lead carbonate, 852 tons of sphalerite, and 330 tons of zinc silicate. Most of the output came from lessees of the Mattes land (old Bullfrog), Eagle Picher Lead Co.'s smelter dump, Connor Investment Co., American Zinc, Lead & Smelting Co., and from the Billy B, Fehm, Imperial, and Burch mines.

The Buxton & Durfee mill purchased crude dirt and concentrates from many small operators, and Pearl Bros. shipped some sphalerite milled in 1920. The Clark concentrating plant recovered considerable lead from the old slag dump at the Eagle Picher smelter at Joplin.

The Webb City-Carterville-Prosperity district had a small output compared with that of former years. The shipments were 285 tons

of galena and 449 tons of sphalerite. The largest production of both lead and zinc was made by lessees on the Connor land. Other properties that yielded shipments of lead or zinc were those of the American Zinc, Lead & Smelting Co., Eleventh Hour Mining Co., and old Troop 40 acres. Most of the shipments from the district consisted of ores from scrapping and clean-ups and old concentrates held in stock. At the end of 1924 the only large plants in operation in southwestern Missouri were the Barnsdall, American Zinc, Lead & Smelting Co., Freehold, and Tulsa-Pittsburg, at Waco; the Clear Preacher, now operated by the S. & M. Mining Co., at Duenweg; numerous lessees on the American Zinc, Lead & Smelting Co.'s land at Granby; the Imperial (now H. & C. C. Mining Co.) and Billy B, near Joplin; and the Lucky Eleven mine, near Carthage.

CENTRAL AND SOUTHEASTERN MISSOURI

A brief description of the ore deposits in central and southeastern Missouri is given in the chapter of Mineral Resources entitled "Silver, copper, lead, and zinc in the Central States in 1915."

Copper, nickel, and cobalt occur in the ore in considerable quantity near Fredericktown and in small quantity irregularly in nearly all deep mines. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district.

In the disseminated-ore district the production increased rapidly after 1869 and is estimated by Buckley to have amounted to 1,202,607 tons of lead concentrates, valued at $59,869,354, for the period between 1869 and 1906, inclusive. The mine production of southeastern and central Missouri has been reported annually since 1907.

Mine production of lead and zinc concentrates in southeastern and central Missouri, 1907–1924

Year	Lead concentrates (galena)		Zinc concentrates			
			Sphalerite		Carbonate and silicate	
	Short tons	Value	Short tons	Value	Short tons	Value
1907–1915	1,945,996	$85,207,971	452	$13,108	8,435	$168,929
1916	307,025	20,720,737	365	14,400	1,030	42,129
1917	306,473	30,070,995	186	16,344	293	7,145
1918	271,506	20,507,064	13	285	235	6,845
1919	229,687	11,590,977	----	----	231	6,576
1920	242,248	19,790,389	----	----	61	1,910
1921	280,358	11,737,400	----	----	----	----
1922	271,294	14,779,869	----	----	----	----
1923	259,320	19,434,633	----	----	----	----
1924	292,604	24,739,819	----	----	----	----

The output of silver in Missouri in 1924 was derived from refining pig lead. The silver was recovered from about 90,000 tons of lead concentrates.

The crude lead ore mined in the disseminated-lead district, amounting to 6,059 700 short tons, yielded 4.83 per cent of lead concentrates

which averaged 67.6 per cent of lead. The average value per ton of lead concentrates was $84.55, compared with $74.94 in 1923, and the concentrates were slightly higher in lead content than in 1923. The output of galena concentrates was 292,487 tons, against 259,157 tons in 1923. As several of the large producers not only mine but also smelt their lead concentrates, the values given for concentrates are to a certain extent arbitrary. The galena concentrates produced in the southwestern Missouri region, which contain a higher lead content, are sold mainly on bids from purchasers, and the values for those concentrates are not comparable with values given for concentrates of the disseminated-lead district.

Analyses of ores mined in the disseminated-lead district in southeastern Missouri and of the various grades of resulting concentrates are given in Mineral Resources for 1919 and 1920.

There were no shipments of zinc carbonate from southeastern Missouri during the year.

The quantity of galena recovered from shallow diggings in Washington and Jefferson Counties was only 117 tons. The ore, which occurs at shallow depths in association with barytes, is mined in a small way and at odd times by the barytes miners.

Small sales of lead ore were made by P. G. Higginbotham, of Fertile; J. F. Blout, of Potosi; Johnson Bros., of Fletcher; and the Washington Land & Mining Co., National Pigments & Chemical Co., and the Valle Mining Co.

The 300-ton concentrating plant and the 100-ton smelter and refinery of the Missouri Cobalt Co., at Fredericktown, were not operated in 1924.

Nearly all the lead produced in southeastern Missouri was mined by the National Lead Co., St. Joseph Lead Co., Desloge Consolidated Lead Co., and Annapolis Lead Co.

In 1924 the St. Joseph Lead Co., from mines in southeastern Missouri, produced 4,498,000 tons of crude ore, which yielded 230,200 tons of lead concentrates, and the smelter produced 148,225 tons of pig lead. The St. Joseph Lead Co. now has five concentrating plants: Rivermines, 4,200 tons; Bonne Terre, 2,400; Leadwood, 2,000; Flat River, 5,000; and Elvins, 3,000. Other concentrating plants are those of the National Lead Co., 2,500 tons, and the Desloge Consolidated Lead Co., 1,500 tons. Besides operating in southeastern Missouri, the St. Joseph Lead Co., through a subsidiary, has done a large amount of drilling in the Joplin region, operated one plant, and was building others.

The Annapolis Lead Co.'s mine in Iron County was operated steadily through the 450-foot shaft. The milling plant, which had a daily capacity of 600 tons, was badly damaged by a cyclone early in 1925.

Additions to the boilers and power plant were made in the mill of the Desloge Consolidated Lead Co., which operated three shafts in 1924.

OKLAHOMA

By J. P. Dunlop

Mine production of lead and zinc in Oklahoma in 1924, by districts

District	Lead concentrates (galena)		Zinc concentrates				Metal content *			
			Sphalerite		Carbonate and silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Miami	91,579	$9,769,868	510,299	$20,883,074			71,122	$11,379,520	266,025	$34,583,250
Quapaw and Sunnyside	303	31,658	5,929	244,835			236	37,760	3,112	404,560
Total, 1923	91,882	9,801,526	516,228	21,127,909			71,358	11,417,280	269,137	34,987,810
	85,474	8,115,868	463,090	18,731,194	54	$520	66,904	9,366,560	242,421	32,969,256

* In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

The following table gives the output of crude lead and zinc ore for the whole State of Oklahoma.

Tenor of lead and zinc ore and concentrates produced in Oklahoma, 1922–1924

	1922	1923	1924
Total crude ore milled in Oklahoma ..... short tons	6,159,500	7,937,200	8,804,000
Total concentrates in crude ore:			
Lead ..... per cent	1.29	1.08	1.04
Zinc ..... do	6.32	5.61	5.76
Metal content of crude ore:			
Lead ..... do	1.04	.86	.83
Zinc ..... do	3.78	3.34	3.41
Average lead content of galena concentrates ..... do	80.4	79.9	79.2
Average zinc content of sphalerite concentrates ..... do	59.9	59.5	59.2
Average value per ton:			
Galena concentrates	$75.12	$94.95	$106.68
Sphalerite concentrates	34.37	40.45	40.93

Mine production of lead and zinc concentrates in Oklahoma, 1891–1924, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Peoria	2,178	$107,053	220	$8,289	2,842	$74,402
Quapaw and Sunnyside	5,357	388,786	46,304	1,964,913	164	2,692
Miami	616,893	51,679,936	2,960,930	125,323,415		
Davis			558	27,399	899	24,592
	624,428	52,175,775	3,008,012	127,324,016	3,905	101,686

Mineral Resources for 1914 contains a brief history of mining in the districts in Oklahoma and also the estimated total production of each district, by years.

The total value of the lead and zinc concentrates shipped from Oklahoma in 1924 was more than in any previous year, and the value of the zinc was greater than the value of any one year's production of any State.

The lead and zinc deposits of northeastern Oklahoma, so far as known, are confined to Ottawa County and form the southwestern extension of the deposits in the Joplin region. There are three camps—Peoria, Quapaw, and Miami—in which extensive mining has been done, and a fourth, the Sycamore Creek district, along the Seneca fault block 2 to 3 miles southwest of Seneca, Mo., in which considerable prospecting has been done and some ore mined. The lead and zinc deposits in southern Oklahoma are near Ravia, at the southeast end of the Arbuckle Mountains, and near Davis, Murray County, at the northwest end of the same range.

The quantity of crude ore milled in Oklahoma increased 866,800 tons in 1924, of which the quantity of ore milled by the old mines near Commerce and for mines near Quapaw and Sunnyside was about 2 per cent. The value of the lead and zinc produced at mines in Oklahoma was $46,405,090, compared with $42,335,816 in 1923. The metal content of lead concentrates increased from 66,904 to 71,358 tons and the zinc from 242,421 to 269,137 tons.

The lead concentrates produced were of slightly lower grade than those shipped in 1923. The average metal content of the sphalerite concentrates from the Miami ore has increased from 51.8 per cent in 1912 to 59.2 per cent in 1924, although the average zinc content of the sphalerite recovered from ore and tailings at the old mines near Commerce in 1924 was only 52.1 per cent.

The Oklahoma portion of the Miami field produced about 77 per cent of the total output of lead concentrates in the Joplin region. The Oklahoma shipments of sphalerite increased 53,138 tons and formed about 70 per cent of the output of sphalerite from the Joplin region.

A history of the mining in the Miami district, including the output by years for 1908 to 1914 and the location of the mines and mills, was given in Mineral Resources for 1914. The reports for 1915 to 1923 contain full reviews of the production, new territory prospected, new mines opened, and new mills erected in those years. A brief description of the ore deposits in the Miami district is given in Mineral Resources for 1915.[4]

In 1924 about 140 mills in the Oklahoma part of the Miami field shipped 91,882 short tons of galena concentrates and 516,228 tons of sphalerite concentrates, an increase of 6,408 tons of galena concentrates and 53,138 tons of sphalerite concentrates compared with the output of 1923. The average value of the galena concentrates increased $11.73 a ton, and the average value of sphalerite concentrates, of which five and one-half times as much was shipped, increased $0.48 a ton.

The high prices paid for galena permitted the mining of ore that was developed at many mines but could not be profitably extracted

[4] Siebenthal, C. E., Zinc, U. S. Geol. Survey Mineral Resources, 1915, Pt. I, 1917, pp. 888-890.

in 1921, 1922, and 1923. The percentage of concentrates recovered was slightly more than in 1923, and the total quantity of crude ore milled increased 11 per cent. Considerable drilling was done outside the proved area; it disclosed new ore bodies of probable value west and east of territory now actively mined, especially between Quapaw and Lincolnville and the Kansas line. Several new mills were erected in this area and a number of shafts sunk. Ore bodies were located in drilling many leases, and many leases were transferred. On the whole, the bodies of ore are smaller than in the main Miami district, and the mills and equipment are on a much smaller scale.

The total quantity of crude ore milled in the Miami region in Oklahoma and Kansas in 1924 was about 11,600,000 tons, and shipments of lead and zinc concentrates exceeding $100,000 in average value were made from each of 115 mines in this region. There were more drill rigs and more shafts and milling plants in operation in this small area than in any other district in the United States.

The quantity of sphalerite concentrates in bins at mines on December 31, 1924, was about 21,000 tons less than that in bins on January 1. As the mines and mills in the Joplin region, if run at capacity on double shift, could if required produce more zinc concentrates than are needed to supply the demand for zinc, the individual mine operators controlled their output by running single shift and by closing mines temporarily on several occasions, thereby reducing the ore in stock, saving the operators from selling below cost of production, and permitting the mining of lower-grade dirt.

Few mines were abandoned during the year, though many were thought to have nearly exhausted their ore bodies. By active prospecting most of the old properties located more ore bodies or took up old stopes and discovered ore at lower levels. In several parts of the region it was found that the early drilling had not been deep enough and that there were runs of ore below the present workings.

The large companies continued to expand their holdings and operations and the price of developed mines and working mills advanced sharply. The changes in the ownership of mines, the opening of new mines, and the erection of new concentrating plants were as follows:

Near Hockerville and St. Louis.—Wade lease was drilled, new shaft sunk, and mill under construction. Toltec mine was closed down. Mill on Scott lease was built and operated by Century Zinc Co. The Right Good mine was taken over by C. F. Dike and others. The Mogul lease was being drilled under an option to the Huttig Lead & Zinc Co.

Near Quapaw and Sunnyside.—The Quapaw Mining Corporation lowered the water on the large tract of ground leased from the Indians and moved the Wolverine mill to the Davenport lease, but it was not operated until 1925. The Reliance mill was completed and operated for a few months. This mine is now owned by the I. V. Mining Co., and the 80-acre lease is being drilled. The West Virginia mine is now owned by the Moose Mining Co. The Century Zinc Co. purchased the Maulsbury and Weeks leases and started erection of mills. The Easy Money lease was prospected and a mill is being built on the property by the Mary Jane Mining Co. Other operators

drilling and sinking shafts are Hawkeye Mining Co., Snow Ball Mining Co., Annex Mining Co., and Jimmy Dooley, who is mining zinc silicate and galena at shallow levels.

Near Century and Douthat.—The Waxahatchie mine was sold to the Underwriters Land Co., and the mill was rebuilt and operated. The Fort Worth and Midas mines and mills were purchased by the Childress Lead & Zinc Co., and the Missouri Mule mine was sold to the Hawkeye Mining Co. The Federal mine is now owned by the Advance Mining Co., while the Bullfrog mine is now owned and operated by the Cortez King Brand Mining Co. The old Quebec mine was worked by the H. B. Mining Co. and later in the year was sold to Remnants (Inc.). The Leonora was worked for a few months by the Golden Rod Mining & Smelting Co. and then was transferred to F. W. Evans. The New Chicago Mining Corporation built a new mill on the west side of their lease.

Near Cardin and Tar River.—The Oklahoma Woodchuck mill was rebuilt farther west on the lease. The Goodeagle mines were operated by the Barnsdall Zinc Co. The K. B. mill was rebuilt and operated after the lease was drilled and the shafts retimbered. The Manhattan mill was burned in November and has not been rebuilt. The old Standard mine was operated by the Blue Streak Mining Co. The S S & G mill was idle in 1924 pending development of new ore bodies. The Auburn mill and lease of 160 acres were sold to the Childress Lead & Zinc Co., and the mill was rebuilt and other improvements made. The Lucky Bill mine was sold by the Childress interests to the Federal Mining & Smelting Co. The American Zinc, Lead & Smelting Co. acquired a 20-acre lease south of Cardin and built a mill in December, 1924.

Near Picher.—The Hunt and Blue Ribbon mines have been taken over by the Eagle Picher Lead Co. The old Foch mine was leased to the Golden Rod Mining & Smelting Co., and the Federal Mining & Smelting Co. operated the Whisk Broom, Gordon, and Lucky Syndicate mines of the Childress Lead & Zinc Co. The St. Joe mine was operated for a short time by the Rialto Mining Co.

The production of the Oklahoma part of the Miami field represented about 140 mills, of which 5 are in the old Commerce camp and the remainder in the territory extending north and northeast to the Kansas State line and east to Quapaw. In the northerly extension of the Miami field in Kansas about 45 mills were in operation at different times in 1924. The quantity of crude ore mined and milled in Oklahoma increased from 7,937,200 tons in 1923 to 8,804,000 in 1924. The average metal content of the sphalerite was 51.8 per cent in 1912, 58.8 per cent in 1919, and 59.2 per cent in 1924.

The separate assays reported showed a zinc content of 50 to 63 per cent, but most of the blende assayed between 58.5 and 60.5 per cent. An assay of a composite sample of 7,414 samples of ore shipped in 1924 from the Miami-Blue Mound region, made by Bruce Williams, of Joplin, Mo., showed an average content of 59.9 per cent of zinc, 1.42 per cent of iron, 0.78 per cent of lead, and 0.46 per cent of cadmium. An assay of a composite sample of blende from 2,896 lots shipped in 1924, made by Joe J. Todd, of Miami, Okla., showed 59.6 per cent of zinc and 1.3 per cent of iron. An assay by Mr. Todd of a composite sample of galena from 512 lots showed 78.5 per cent of

lead. The average zinc assay as computed from the reports of all the companies selling concentrates was 59.6 per cent.

The recovery of concentrates from all the mines in Oklahoma averaged about 1 ton of galena to 5.6 tons of sphalerite. The proportion of galena concentrates recovered from the "dirt" mined showed wide variations in different mines, ranging from less than 1 ton of galena to 100 tons of sphalerite to 2½ tons of galena to 1 ton of sphalerite. Only a few mines reported the recovery of no lead.

The total shipments from those properties that may be properly classed as in the Tar River-Cardin-Douthat area, of which there were a greater number than in the other areas, amounted to 35,914 tons of galena and 207,058 tons of sphalerite. About 3,538,300 tons of "dirt" was milled, and the recovery in concentrates averaged about 6.84 per cent. A few of the mines near Cardin yielded half as much galena as sphalerite; in a few mines near Douthat the proportion of galena was as little as 4 per cent, and the proportion of galena to sphalerite on the whole was considerably less than that recovered from the mines near Picher but more than that from the mines near Zincville. The proportion of galena to sphalerite recovered at all the mines in the vicinity of Douthat was about 1 ton of galena to 9.74 tons of sphalerite; in the Tar River section the mines yielded about 1 ton of galena to 4.84 tons of sphalerite.

The territory east of Picher, near the Hockerville and Zincville (St. Louis) camps, was more productive than in 1923, when the shipments from 26 mines were 13,166 tons of galena and 130,244 tons of sphalerite; in 1924 the shipments from 26 mines were 13,905 tons of galena and 145,180 tons of sphalerite from 1,600,400 tons of ore treated. The sphalerite averaged about 59.4 per cent in zinc content, and the galena 78.4 per cent in lead content.

The production of the mines near Picher showed an increase. In 1923 the quantity of ore milled was 2,999,300 tons, and the shipments were 34,513 tons of galena and 132,138 tons of sphalerite. In 1924 the quantity of ore milled was 3,483,000 tons, and the shipments were 40,500 tons of galena and 156,664 tons of sphalerite, with an average recovery of 5.54 per cent in concentrates. The zinc content of the sphalerite averaged about 58.9 per cent and the lead content of the galena 79.4 per cent.

At Commerce several old mines, including the Gordon McBee worked by the Commerce Mining & Royalty Co., the Lost Trail, Turkey Fat, and Mispah, and the Emma Gordon (leased to the Incas Mining Co.), were operated in 1924. Shipments from Commerce were 1,260 tons of galena and 1,397 tons of sphalerite. The development work at the Gordon McBee, Prairie, and Incas mines indicates an increased output in 1925. The mines at Commerce produce a large proportion of galena, and they can be profitably operated on comparatively low-grade ore.

No shipments from Peoria, the oldest mining camp in Oklahoma, were reported in 1924. The total production of concentrates in the Quapaw district was comparatively small, and none of the mills near Lincolnville were in operation.

The shipments from mines near Quapaw and Sunnyside were 303 tons of galena and 5,929 tons of sphalerite, most of which came from Vantage No. 2, Hope, and West Virginia mines. Small shipments were made from the Beard, Jefferson, and Reliance mines. Develop-

ment was done on many leases, and several mills have been erected which will ship in 1925. Among these are the Davenport, Vinegar Hill (Maulsbury), Easy Money, Snow Ball, and Annex.

WISCONSIN

By J. P. Dunlop

Mine production of lead and zinc in Wisconsin in 1924, by districts

District	Lead concentrates		Zinc concentrates				Metal content •			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Benton—New Diggings	592	$56,385	21,920	$349,710	------	--------	414	$66,240	5,185	$674,050
Cuba City	67	5,988	4,060	63,210	------	--------	49	7,840	904	117,520
Dodgeville	23	2,583	413	9,861	------	--------	17	2,720	151	19,630
Hazel Green—Livingston	93	9,536	17,677	272,018	------	--------	70	11,200	3,978	517,140
Highland—Mineral Point	55	3,393	554	14,301	583	$10,058	32	5,120	374	48,620
Linden	156	18,446	1,799	64,503	------	--------	113	18,080	827	107,510
Platteville	54	5,080	349	10,737	------	--------	42	6,720	147	19,110
Shullsburg	712	73,974	8,029	179,786	------	--------	517	82,720	2,461	319,930
Total, 1923	1,752	175,385	54,801	964,126	583	10,058	1,254	200,640	14,027	1,823,510
	978	80,823	47,588	889,624	1,428	25,081	734	102,760	13,211	1,796,696

• In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1921–1924

	1921	1922	1923	1924
Total crude ore, short tons	136,300	221,000	454,000	652,000
Total concentrates in crude ore:				
Lead, per cent	0.95	0.43	0.22	0.27
Zinc, do	12.07	11.14	9.10	8.49
Metal content of crude ore:				
Lead, do	.73	.32	.17	.20
Zinc, do	3.05	3.58	3.17	2.77
Average lead content of galena concentrates, do	76.1	74.8	76.6	73.1
Average zinc content of sphalerite concentrates, do	25.3	33.9	35.2	32.6
Average zinc content of zinc carbonate concentrates, do	--------	32.8	33.1	33.4
Average value per ton:				
Galena concentrates	$50.83	$66.13	$82.64	$100.11
Sphalerite concentrates	8.52	15.30	18.69	17.59
Zinc carbonate concentrates	--------	14.09	17.56	17.25

The crude ore yields from 5 to more than 20 per cent of concentrates. The average recovery in concentrates decreased from 9.32 per cent in 1923 to 8.76 per cent in 1924, reflecting the increase in the quantity of crude ore milled. Some tailings were treated in 1924 at New Diggings and Hazel Green, and some sphalerite concentrates in bins at mines milled prior to 1924 were shipped. The mining methods are determined largely by the mode of occurrence of the ores, but otherwise are similar to those in vogue in working the pockety ores at

Joplin. The milling methods used in the Wisconsin field have been described by Walter Schultz,[5] of the Wisconsin Zinc Co.

The zinc-carbonate ore, which is mined almost entirely in the Highland and Mineral Point districts, is purchased mainly by the Mineral Point Zinc Co. and made into zinc oxide in the plant at Mineral Point, Wis. Some carbonate ores were produced, and the sales in 1924 were 583 tons, or 845 tons less than in 1923.

The metal content of the raw sphalerite concentrates shipped by the mines ranged from 10 to 54 per cent, but nearly half of the concentrates sold ranged between 28 and 35 per cent. The zinc content of the roasted sphalerite concentrates shipped was 54 to 60 per cent.

The value of the mine output of lead and zinc in Wisconsin was $2,024,150, against $1,899,456 in 1923. The lead concentrates sold increased from 978 tons in 1923 to 1,752 tons in 1924, and the sphalerite concentrates sold increased from 47,588 to 54,801 tons. The metal content of the lead concentrates was 520 tons more than in 1923. The zinc content of the sphalerite and zinc-carbonate concentrates increased 816 tons.

Comparatively little development work was done, except by two of the larger operators, and few new mines were opened, though a number of old properties were unwatered and operated.

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette Counties and contain the most valuable part of the ore deposits of the upper Mississippi Valley region, a historical review of which is given in the Illinois section of this report in Mineral Resources for 1914. A detailed description of the Wisconsin lead and zinc districts and of the mines in each district to the year 1906 is given by Bain.[6] The development of the mines subsequent to Bain's report and the output of Wisconsin mines have been set forth in Mineral Resources for 1907 to 1923.

Roasting and electromagnetic separation have been utilized in the district for many years to produce a marketable zinc product. Comparatively few of the concentrating plants are equipped with roasters, but practically all the larger mining interests own or control separating plants.[7] The roasting and separating plants operated in Wisconsin in 1924 were those of the National Zinc Separating Co., at Cuba City; the Blockhouse, at Platteville; the Mineral Point Zinc Co., at Mineral Point; and the Northern Mines Co., at Shullsburg. The shipments made came from about 40 mines, many of which were small and were operated spasmodically.

Approximately 61,800 tons of sphalerite concentrates were shipped in 1924 from mines in the upper Mississippi Valley region (Illinois and Wisconsin), and all of this material except about 2,000 tons was treated at roasting and separating plants in Wisconsin. The average zinc content of the raw sphalerite concentrates from Wisconsin sold in 1924 was 32.6 per cent, and the average value per ton was $17.59; the corresponding content and value for 1917 were 32.8 per cent and $29.48; for 1918, 34.6 per cent and $25.70; for 1919, 35.3 per cent and $21.90; for 1920, 32.4 per cent and $22.64; for 1921, 25.3 per cent and

[5] Schultz, Walter, Milling Wisconsin lead-zinc ores, Eng. and Min. Jour., July 14, 1917, pp. 82–84.
[6] Bain, H. F., Zinc and lead deposits of the upper Mississippi Valley, U. S. Geol. Survey Bull. 294, pp. 81–148, 1906.
[7] Deutman, E. G., The roasting and magnetic separation of Wisconsin zinc ores, Eng. and Min. Jour., June 28, 1919, pp. 1107–1111.

$8.52; for 1922, 33.9 per cent and $15.30; and for 1923, 35.2 per cent and $18.69.

The percentage of concentrates recovered from crude ore is much higher in Wisconsin than in the Joplin region, but the assay of the raw zinc concentrates shows 10 to 45 per cent less zinc content. The new concentrating plants are equipped with more tables than formerly. The concentrates from the tables have a very high iron content, but this can be remedied by roasting.

Only three of the mines owned by the Mineral Point Zinc Co. (the Penna-Benton, Coker, and Hoskins) were operated in 1924, though the mines of the Wisconsin Zinc Co. were taken over during that year. The output from the last-named properties was mainly from tailings at the Champion and Winskill mines. The larger mines and mills operated in 1924 were the Winrock, Fields Meloy (which was worked out in 1924), Nightingale, Penna-Benton, and Hoskins, at New Diggings; the Connecting Link, Call, and Defol, at Cuba City; the Lucky Five, at Dodgeville; the Coker, at Livingston; the Monmouth, at Hazel Green; the Blockhouse, at Platteville; and the Northern Mines Co., Rodham McQuitty, and Copeland at Shullsburg. The Vinegar Hill Zinc Co. operated several mines throughout 1924 including the Fields Meloy at New Diggings and the Defol at Cuba City, which were given up during the year. Most of the concentrates shipped by the Vinegar Hill Zinc. Co. came from the Monmouth mines at Hazel Green, the Rodham McQuitty mine at Shullsburg, and the Copeland near Shullsburg. The Rodham McQuitty mine, a large producer of lead and zinc, was purchased early in 1924. The tailings mills operated in 1924 were those of Stadel & Lightcap, at the Cleveland mine; the Domestic Mining Co., at the Champion mine; the Burr Milling Co., at the Burr mine; Hillary & Lawyer, at the Winskill mine; and Mayfield & Moore, on the Richardson land at New Diggings.

The owners of the Connecting Link mine, near Cuba City, operated only one of their two mills in 1924.

The large producers of zinc carbonate ore were Delaney & Co., Williams & Co., Waters & Fecht, Minter Mining Co., and Salzman & Co. at Highland. In addition to the zinc carbonate ore shipped about 1,450 tons of mixed sphalerite and zinc carbonate and silicate ores which were included with the sphalerite were sold in 1924. Most of the mixed ore had a zinc content of 45 to 48 per cent. Mines in the Shullsburg district produced about one-half of the galena shipped in 1924, and most of the remainder came from mines at New Diggings.

The largest producer of lead and zinc concentrates from a small plant in 1924 was the Rule Mining Co. at Linden; the raw sphalerite sold averaged 54.4 per cent, which is much higher than usual in Wisconsin. The 125-ton mill is equipped with Butchart tables.

For descriptions of the old mines, concentrating plants, and roasting plants in which no essential changes were made during 1924 the reader is referred to Mineral Resources for recent years.

MANGANESE AND MANGANIFEROUS ORES

By Helena M. Meyer [1]

INTRODUCTION

As a result of the tariff on manganese ore, which became effective September 22, 1922, many new operators were active in 1924, but the number of shippers who contributed only one or two carloads was surprisingly large. A good example of the small total shipments by individual operators was shown in Georgia where eight producers of high-grade ore containing 35 per cent or more of manganese shipped only 1,093 gross tons, an average of less than 140 tons per shipper. As the number of shippers of high-grade ore was practically the same in 1924 as in 1923, and as there were new operators in 1924, some 1923 operators evidently have either worked out their deposits or found they could not produce manganese from them at a profit.

Altogether the shipments of high-grade ore increased 79 per cent—from 31,500 gross tons in 1923 to 56,515 tons in 1924. This increase was mainly in Montana, where considerably more manganese ore was produced than in all the other States together, and also from Washington. The shipments of manganese ore from Washington were the first of importance from that State. By far the larger part of the ore from Montana is chemical ore from Philipsburg, whereas the ore from Washington is metallurgical ore. In 1924 less than 45 per cent of the high-grade ore shipped from mines in this country was suitable for chemical purposes, but in 1923 nearly 65 per cent of it was. These figures seem to indicate that shipments of chemical ore have decreased, whereas, in fact, they increased, but shipments of ore for other purposes have increased in larger proportion.

The increase in the shipments of manganese ore containing 35 per cent and more of manganese and the increase in imports made approximately 25 per cent more ore available in 1924 than in 1923. The shipments of ferromanganese from domestic furnaces and the imports of spiegeleisen also increased in 1924, but the imports of ferromanganese and domestic shipments of spiegeleisen decreased so much that altogether less manganese was available in the form of ferromanganese and spiegeleisen than in 1923. Considerably less manganese was required in 1924, however, because the production of steel fell from 44,943,696 gross tons in 1923 to 37,931,939 tons in 1924.

Most of the States reported increased shipments of high-grade manganese ore in 1924, but shipments decreased in Arizona, Arkansas,

[1] The statistics of imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Georgia, and Oklahoma. In 1924, for the first time since 1920, the value of high-grade shipments passed the million-dollar mark, being $1,307,477.

The prices for manganese ore at seaboard showed little variation during 1924. According to the Iron Trade Review they ranged from 38 to 43 cents a unit, which for 50 per cent ore, including the tariff, represents $30.20 to $32.70 a ton.

Since September 22, 1922, the Bureau of Foreign and Domestic Commerce has reported the imports of manganese ore into the United States in terms of manganese content of ores imported instead of in terms of gross weight of ores as before. As imports from Cuba, however, are not subject to the duty imposed on manganese ores, they are still reported in terms of gross weight. For purposes of comparison with former years the Bureau of Mines has made estimates of the gross weight of ores imported in 1922, 1923, and 1924, assuming a manganese content of approximately 48 per cent for all countries for which figures of gross weight are not available. This calculation shows that approximately 425,000 gross tons of manganese ore was imported in 1922, 419,000 in 1923, and 505,000 in 1924.

During 1924 there were rumors of the leasing by the Russian Government of the important Chiatouri manganese deposits in Georgia to W. A. Harriman & Co., of New York City. Recently, according to reports, the Harriman interests have acquired a 20-year concession on these deposits.

PRODUCTION

Manganese alloys and ore produced in the United States and imported from principal foreign sources, 1917–1924, in gross tons

Year	Steel (production)[a]	Ferromanganese		Spiegeleisen		Manganese ore				
		Shipments	Imports	Shipments	Imports	Shipments[b]	Total imports	Imports from—		
								Russia	India	Brazil
1917	45,060,607	260,225	41,969	189,241	3,968	129,351	629,972	----------	48,975	512,517
1918	44,462,432	306,076	27,168	263,861	1,969	305,869	491,303	----------	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	54,957	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	[c]599,764	18,762	71,238	421,523
1921	19,783,797	111,374	9,077	69,230	307	13,531	[c]392,606	----------	113,730	262,468
1922	35,602,926	161,612	[d]100,725	70,253	8,151	13,404	[d]425,000	{--------- [f] 1,642	[e] 24,250 [f] 298	[e]234,598 [f] 40,595
1923	44,943,696	226,365	[d]113,833	134,086	4,668	31,500	[d]419,000	[g] 11,670	[g] 25,568	[g] 88,036
1924	37,931,939	232,821	[d] 56,588	76,179	7,433	56,515	[d]505,000	[g] 41,097	[g] 54,566	[g] 54,938

[a] According to American Iron and Steel Institute.

[b] Exclusive of small quantities of ore shipped for use in fluxing.

[c] Exclusive of 7,173 tons in 1920 and 8,748 tons in 1921 reported by Bureau of Foreign and Domestic Commerce as manganese ore. The value of this "ore" ranged from $46 to $292 a ton; consequently the Bureau of Mines believes that the figures represent imports of ferromanganese, spiegeleisen, manganese chemicals, and perhaps some chemical ore.

[d] Prior to Sept. 22, 1922, the Bureau of Foreign and Domestic Commerce reported the gross weight of manganese ore and ferromanganese imported, but since that date has reported only the manganese content. This figure is a Bureau of Mines estimate of the gross weight of ore or alloy imported. For the figures reported by the Bureau of Foreign and Domestic Commerce, see the tables on pages 98 and 161.

[e] For Jan. 1 to Sept. 21, 1922. Figures represent gross weight of manganese ore imported.

[f] For Sept. 22 to Dec. 31, 1922. Figures represent manganese content of ore imported.

[g] Figures represent manganese content of ore imported.

Manganese ore produced in the principal countries, 1920–1924, in metric tons

[Prepared by L. M. Jones, of the Bureau of Mines]

Country	Percentage of manganese	1920	1921	1922	1923	1924
North America:						
Canada		589	62	66		530
Costa Rica	37–48	[a] 3,253	[a] 589	(b)	(b)	(b)
Cuba	36–48	2,482	2,930	4,351	19,636	25,310
Mexico	40+	1,137			2,246	(c)
Newfoundland		[d] 168	[d] 384			(c)
Panama [e]	50±			(f)	406	
United States—						
Continental (exclusive of fluxing ore)	35+	95,935	13,748	13,619	32,006	57,422
Porto Rico [a]	35+	(c)	(c)	(c)	2,799	4,698
South America:						
Brazil [a]	38–50	453,737	275,694	340,706	235,831	159,229
Chile	40–48	11,633	23	900	4,287	4,243
Europe:						
Austria		(g)	(g)	(g)	(g)	(g)
Czechoslovakia		50,295	43,541	23,557	42,543	79,133
France	30+	10,302	3,519	5,220	335	3,680
Germany	30+	7,270	3,385	5,532	10,245	(c)
Italy	30–50	13,740	4,450	4,529	9,605	12,189
Portugal	38–70	925	353	239	(c)	(c)
Rumania	42	[h] 3,369	[h] 3,035	[h] 5,392	[h] 12,511	6,482
Russia	41–48	[i] 5,243	[i] 12,191	[i] 51,504	[i] 76,585	[j] 427,195
Spain	29+	21,256	20,098	25,455	28,615	20,840
Sweden		14,960	6,253	4,528	5,203	10,885
United Kingdom	30+	13,082	522	254	2,053	2,496
Yugoslavia		5,327	910	1,122	5,145	4,643
Asia:						
China [a]		25,323	25,627	19,230	27,672	38,500
Dutch East Indies		4,179	2,093	3,233	5,243	8,482
India	47–52	748,259	690,189	482,015	706,210	815,894
Japan	50+	5,474	3,881	4,440	5,494	7,585
Africa:						
Algeria [a]		5,250	1,893		661	(c)
Egypt		77,562	55,065	104,143	132,384	150,194
Gold Coast		41,628	7,311	67,174	141,875	[a] 254,000
Morocco (French)	45–48	4,375			(c)	(c)
Tunisia	42+	1,300	1,500	180	1,153	3,220
Union of South Africa	49–55	61	287	157	393	530
Oceania:						
Australia—						
New South Wales		2,572	3,571	2,436	2,597	4,457
Queensland		15	846	68	75	
Victoria			10	152		
South Australia		522	1,622	649	171	321
Western Australia [a]			16	18	22	20
New Caledonia		2,244	4,200	1,083	64	

[a] Exports.
[b] It is reported that no work has been done on the manganese deposits since 1920.
[c] Data not available.
[d] Exports for year ended June 30 of the year stated in heading of column.
[e] Imports into the United States. Figures for production and exports not available. Figures for 1923 represent manganese content of ore.
[f] Less than 1 ton.
[g] Estimated manganese content of manganiferous iron ore produced was as follows: 1920, 9,409 tons; 1921, 13,345 tons; 1922, 19,947 tons; 1923, 24,033 tons; 1924, 15,007 tons.
[h] Year ended Mar. 31 following that stated in heading of column.
[i] Exclusive of Georgia and other parts of the Caucasus. The output of Georgia for 1920 was 91,749 tons.
[j] Figures for the operating year Oct. 1, 1923, to Sept. 30, 1924. Output of the Caucasus deposits, which amounted to 320,132 tons, is included.

Official figures published in the Mining Journal, Moscow, of February, 1925, give the output of the Chiatouri mines, Russia, as 320,132 metric tons during the operating year October 1, 1923, to September 30, 1924. Although this is a large increase over the production in recent years—the mines of Chiatouri were practically idle during the revolutionary period—it represents less than one-third of the production in 1913. The properties are capable of much larger output, and under efficient management will furnish a large part of the world's output of manganese ore. Production figures for the remainder of

Russia for the operating year 1923–4 are reported as 107,063 metric tons; in the calendar year 1923 the production was 76,585 metric tons.

The production of manganese ore in India was 815,894 metric tons in 1924; it was greater than during any year since 1913, when 828,128 metric tons were produced. In 1920 the production was 748,259 tons and in 1923 it was 706,210 tons.

Of considerable interest is the large increase in the production of manganese ore in the Gold Coast, Africa. The first figures of shipments for the Gold Coast, 4,326 metric tons, covered the period from August, 1916, to the end of the year. In 1923 the output increased to 141,875 metric tons. A. E. Kitson,[2] director of the Geological Survey of the Gold Coast, said, on November 4, 1924, that the African Manganese Co. was producing at the rate of 240,000 tons a year, and that the ore was specially suitable for the manufacture of ferromanganese and averages 50 to 53 per cent of manganese, 2 to 4 per cent of iron, 3 to 7 per cent of silica, and 0.1 to 0.12 per cent of phosphorus. Exports for 1924 amounted to 254,000 metric tons.

According to Weld[3] the shipments of manganese ore from Cuba in 1924 were almost entirely of metallurgical grade, carrying 46 to 48 per cent manganese. The ore came mainly from Bueycito, with lesser amounts from the Cauto district north of San Luis.

Manganese ore exports from Brazil have declined considerably in the last few years, and in 1924 amounted to only 159,229 metric tons, less than one-half the exports in 1922, but approximately equal to the pre-war average.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1919–1924, by States

State	Ore containing 35 per cent or more of manganese			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Shippers	Gross tons	Value	Shippers	Gross tons	Value	Shippers	Gross tons	Value
Total, 1919	42	54,957	$1,791,118	24	211,632	$965,660	9	112,303	$352,570
Total, 1920	56	94,420	2,396,235	31	357,279	1,450,518	6	279,687	644,572
Total, 1921	14	13,531	495,097	6	8,439	42,755	3	62,670	147,576
Total, 1922	18	13,404	455,160	9	344,674	1,071,780	6	251,614	632,039
1923									
Alabama	1	(a)	(a)	4	694	8,067			
Arizona	1	245	(a)						
Arkansas	8	3,768	73,507	7	4,773	20,047			
California	2	(a)	(a)						
Colorado	3	2,278	41,203	8	18,348	68,204			
Georgia	5	1,502	23,380	11	14,718	80,135	7	15,530	43,711
Michigan				1	20,079	80,517	1	204,700	(a)
Minnesota				4	253,634	880,575	3	499,181	1,406,385
Montana	6	21,916	674,509						
New Mexico	3	179	3,693	3	6,759	17,398			
Oklahoma	1	(a)	(a)						
Tennessee	3	213	5,611						
Virginia	3	987	42,020	3	661	3,685			
Wisconsin							1	353,046	(a)
Undistributed		412	11,050						2,148,231
	36	31,500	874,973	41	319,666	1,158,628	12	1,072,457	3,598,327

[a] Included under "Undistributed." Bureau of Mines not at liberty to publish.

[2] Kitson, A. E., "The mineral resources of the Gold Coast," Mining Magazine, vol. 32, 1925, No. 1, pp. 9–17.

[3] Weld, C. M., Cuba: Eng. and Min. Jour.-Press., vol. 119, 1925, No. 3, p. 122.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1919–1924, by States—Continued

State	Ore containing 35 per cent or more of manganese			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Shippers	Gross tons	Value	Shippers	Gross tons	Value	Shippers	Gross tons	Value
1924									
Alabama	3	1,242	$24,954	9	611	$6,722			
Arizona	1	42	798						
Arkansas	6	3,400	60,350	6	7,991	37,170			
California	2	850	(a)						
Colorado	2	5,338	48,042	7	27,058	109,289	1	3,891	(a)
Georgia	8	1,093	18,304	19	14,182	73,684	6	6,353	$16,558
Michigan				1	50,556	157,184	1	39,939	(a)
Minnesota				4	159,915	439,132	3	361,527	970,351
Montana	6	35,445	939,919						
Nevada	3	1,310	13,579	3	2,591	15,997			
New Mexico	2	775	(a)	2	23,246	(a)			
Tennessee	2	455	11,611						
Utah				2	116	1,010			
Virginia	3	1,565	59,220	2	204	(a)			
Washington	1	5,000	100,000						
Wisconsin							1	175,316	606,593
Undistributed			30,700			89,202			120,441
	39	56,515	1,307,477	55	286,470	929,390	12	587,026	1,713,943

a Included under "Undistributed." Bureau of Mines not at liberty to publish.

The following table gives the production of manganese ore in the United States from 1838 through 1924. It shows that over one and one-half times as much ore has been produced in the eight years following 1916 as in the 79 years from 1838 to 1916, inclusive. Mainly because of the World War and the accompanying urgent demand for manganese ore, over 26 per cent of the total for the 87 years—1838–1924—was produced in one year, 1918. War prices seem necessary for a large domestic production of ore, and even when war prices prevailed the domestic production had to be supplemented by heavy imports of manganese ore and alloys to cover the requirements of the steel industry.

Although Montana did not produce manganese on a commercial scale until 1916 and its output to the end of that year represented less than 1½ per cent of the total for the country, by the end of 1924 nearly 39 per cent of that total had originated in Montana. Montana shipments have consisted mainly of chemical ore from Philipsburg, supplemented by rhodochrosite ore from the Emma mine at Butte. The output from Virginia to the end of 1924 represents 25 per cent of the country's total, as compared with 55 per cent to the end of 1916, and ranks second. Georgia has produced nearly 10 per cent of the total, Arkansas about 8 per cent, and California over 6 per cent.

An outstanding feature of the domestic situation is that the production of ore containing 35 per cent or more of manganese for the 87 years from 1838 to 1924, inclusive (1,157,952 tons), is less than two and one-half times the average quantity of ore imported in the last eight years and is not much more than twice the quantity imported in 1924, when the imports were subject to a tariff.

Manganese ore (containing 35 per cent of manganese or more) produced [a] in the United States, 1838–1924, in gross tons

State	1838–1916 [b]	1917	1918	1919	1920	1921	1922	1923	1924	Total, 1838–1924 [b]
Alabama	314	264	709	40	57			(c)	1,242	c 2,626
Arizona	3,399	14,802	17,612	529	2,402	328	203	245	42	39,562
Arkansas	57,482	10,140	7,731	2,558	3,445	728	2,264	3,768	3,400	91,516
California	22,036	14,196	24,067	11,289	1,733		(d)	(d)	850	d 74,781
Colorado	260	60	4,821	11,166	3,643	490		2,278	5,338	28,056
Georgia	99,516	3,614	6,679	48	341			1,502	1,093	112,793
Michigan	137									137
Missouri	44									44
Montana	6,555	61,109	199,932	24,993	76,441	11,129	9,751	21,916	35,445	447,271
Nevada	345	3,450	19,872	78	1,240		(d)		1,310	d 26,313
New Jersey			64							64
New Mexico		2,603	3,126		2,053			179	775	8,736
North Carolina	181	102	315							598
Oklahoma	206							(c)		c 206
Oregon			198							198
Pennsylvania	1,113									1,113
South Carolina	1,367	405	100							1,872
South Dakota	19		31							50
Tennessee	3,054	1,996	4,162	328	502	139	113	213	455	10,962
Texas		25	380							405
Utah	5,177	4,195	5,100							14,472
Vermont	1,625									1,625
Virginia	254,377	12,360	10,928	3,928	2,523	717	800	987	1,565	288,185
Washington	(e)								5,000	e 5,000
Wyoming		30	42		40					112
Undistributed	1,198						d 273	c d 412		c d 1,255
	458,405	129,351	305,869	54,957	94,420	13,531	13,404	31,500	56,515	1,157,952

[a] Beginning with 1910 figures represent shipments and exclude fluxing ore.

[b] Prior to 1916 some States in some years produced insignificant quantities of manganese ore. Some of these quantities could not be published separately without disclosing confidential information, so they were included with totals for other States. The quantities so included are more or less compensating and are too small to affect State totals materially.

[c] The small tonnages for Alabama and Oklahoma in 1923 may not be shown but are included under "Undistributed" both for 1923 and in the total for 1838–1924.

[d] Tonnages for California in 1922 and 1923 and for Nevada in 1922 are included under "Undistributed" but are shown under the proper State in the total for 1838–1924.

[e] The small production from Washington in 1916 may not be shown. It is, however, included in the United States total.

The shipments of ferruginous manganese ore (ore containing 10 to 35 per cent of manganese) decreased from 319,666 gross tons, valued at $1,158,628, in 1923 to 286,470, tons, valued at $929,390, in 1924, a decrease of 33,196 tons and $229,238. This decrease is due almost entirely to smaller shipments from Minnesota, as shipments from all other States of any importance were either essentially the same or larger. The more notable increases were from Arkansas, Colorado, Michigan, and New Mexico. Nevada, which shipped none in 1923, shipped 2,591 tons in 1924.

As compared with 1923, the shipments of ore containing 5 to 10 per cent of manganese decreased over 45 per cent in 1924—from 1,072,457 gross tons, valued at $3,598,327, to 587,026 tons, valued at $1,713,943. One reason for this large decrease is that the 1924 output of the Tilden mine of the Oliver Iron Mining Co., at Bessemer, Mich., was again classified as iron ore. For just one year (1923) the Tilden ore contained enough manganese to justify its classification as a manganiferous iron ore. On the other hand, the Ottawa mine of the Montreal Mining Co., at Gile, Wis., again in 1924 shipped ore containing

enough manganese to cause its inclusion with ore containing 5 to 10 per cent of manganese. Decreased shipments of manganiferous iron ore from Minnesota and Wisconsin in 1924 contributed to the large decrease in shipments of ore containing 5 to 10 per cent of manganese.

Manganese and manganiferous ore shipped from mines in the United States, 1910–1924, in gross tons

Year	Manganese and manganiferous ores, exclusive of fluxing ore			Fluxing ore containing manganese		
	Ore containing 35 per cent of manganese or more	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Ore containing 35 per cent of manganese or more	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese [a]
1910	2,258				41,260	19,841
1911	2,457	2,602	82		34,982	6,771
1912	1,664	2,782	117		38,081	10,537
1913	4,048	9,650			41,862	7,891
1914	2,635	60,484			31,182	6,599
1915	9,558	64,204	10,616	55	116,749	4,166
1916	31,474	316,600	81,615		137,253	8,858
1917	129,351	576,608	108,409	54	154,151	21,776
1918	305,869	818,003	236,103		98,160	18,196
1919	54,957	211,632	112,303	365	98,202	11,596
1920	94,420	357,279	279,687		123,970	6,728
1921	13,531	8,439	62,670		22,962	3,028
1922	13,404	344,674	251,614	2,278	27,705	1,666
1923	31,500	319,666	1,072,457	769	40,770	1,004
1924	56,515	286,470	587,026	1,833	24,972	
	753,641	3,379,093	2,802,699	5,354	1,032,261	128,657

[a] Includes ore containing less than 5 per cent of manganese, as follows: 1915, 796 tons; 1916, 1,026 tons; 1917, 141 tons; 1918, 1,684 tons; 1919, 844 tons; 1920, 1,250 tons; 1921, 998 tons; 1922, 117 tons.

Ferruginous manganese ore and manganiferous iron ore shipped from the Cuyuna district, Minn., 1917–1924, and total, 1913–1924, in gross tons

Mine	Ore containing 10 to 35 per cent of manganese							
	1917	1918	1919	1920	1921	1922	1923	1924
Algoma (Hoch)	[a] 84,125	21,200	24,478	[b] 5,115				
Arko		733	500	2,044				
Cuyuna Mille Lacs (Louise)	112,554	132,515						12,337
Ferro	([a])	57,261	14,556					
Gloria			2,637	738				
Hillcrest							430	
Hopkins		36,651	5,849					6,190
Joan, Nos. 1 and 4	8,375	27,931		8,500				
Kennedy								
Mahnomen	4,000	132,726	11,472	9,842		69,644	74,247	119,781
Mangan, Nos. 1 and 2	52,290	67,796	92	10,979				
Martin		349						
Merritt Nos. 1 and 2	33,180	78,555		33,239			[c] 24,387	
Milford (Ida Mae)		5,134		[b] 20,851				
Portsmouth						38,000		
Sagamore			79,248	163,904		197,449	154,570	21,607
Sultana	65,018	64,158	120	[b] 38,312				
	359,542	625,009	138,952	293,524		305,093	253,634	159,915

[a] Shipments from Ferro mine included with Algoma mine for 1917. Not reported separately.
[b] According to the Iron Trade Review.
[c] According to the Lake Superior Iron Ore Association.

Ferruginous manganese ore and manganiferous iron ore shipped from the Cuyuna district, Minn., 1917–1924, and total, 1913–1924, in gross tons—Continued

Mine	Ore containing 5 to 10 per cent of manganese								Total, 1913–1924
	1917	1918	1919	1920	1921	1922	1923	1924	
Algoma (Hoch)									[a] 165,710
Arko									3,277
Cuyuna Mille Lacs (Louise)		25,560						9,737	499,124
Ferro									[a] 86,527
Gloria									3,375
Hillcrest	9,590	20,242			15,473	4,100			52,547
Hopkins									48,690
Joan, Nos. 1 and 4									44,806
Kennedy				9,511					9,511
Mahnomen	82,000	175,648	90,896	81,066	41,057	110,590	282,883	128,967	1,457,819
Mangan, Nos. 1 and 2		4,679							166,165
Martin		1,073							1,422
Merritt, Nos. 1 and 2									169,361
Milford (Ida Mae)						870	77,300		104,155
Portsmouth				158,336		133,000	138,998		468,334
Sagamore			7,324					222,823	846,925
Sultana									202,978
	91,590	227,202	98,220	248,913	56,530	248,560	499,181	361,527	4,330,726

[a] Shipments from Ferro mine included with Algoma mine for 1917. Not reported separately.

Manganiferous silver ore shipped from mines in the United States, 1917-1924, in gross tons [a]

Year	Arizona	Colorado		Montana	Nevada	New Mexico	Utah
		For fluxing	For other purposes				
1917	32,409	20,600	104,115		122,872		100
1918	10,854	24,931	99,110		80,096	475	
1919	1,964	29,769	11,055		77,815	250	
1920	345	34,670	11,056		95,142	541	
1921		10,819	924		14,871	300	
1922		13,951		6,656		8,764	
1923		10,376	18,348	3,596	28,571		
1924		4,488	30,949	5,607	16,710		

[a] All used for fluxing except that from Colorado designated " For other purposes".

MANGANESE MINING IN SOME OF THE CHIEF STATES

Alabama.—For 1924 the shipments of high-grade manganese ore (ore containing 35 per cent or more of manganese) were the largest ever recorded, namely, 1,242 gross tons as compared with 709 tons in 1918, the second highest year. The ore which came from Etowah and Talladega Counties was shipped to the Tennessee Coal, Iron & Railroad Co. and had the advantage of being mined near the plants using it.

Arkansas.—The shipments of high-grade ore in 1924 were 368 gross tons below the 1923 figures, but the shipments of ore containing 10 to 35 per cent of manganese increased 3,218 tons. Producers in the Batesville-Cushman field are using small washing plants instead of large ones for manganese ore, because the small plants can be moved

from place to place as desired. According to the Manufacturers' Record of April 23, 1925, Shell and Beatty were completing a small washing plant, with a capacity of 75 tons of crude ore a shift, at the Roach Hill mine, the 500-ton plant at the mine of the H. B. Snyder interests was washing about one-fifth plant capacity, and the Scott Mining Co. had just completed a 100-ton washing plant on the Alder land, and was also interested with W. G. Rinehart in the Blowing Cave mine, where a 150-ton washing plant was nearing completion.

Colorado.—Shipments of high-grade ore in Colorado increased from 2,278 gross tons in 1923 to 5,338 tons in 1924. The 1924 shipments were the largest recorded, with the exception of 11,166 tons in 1919. There was also a large increase in low-grade production.

Georgia.—The number of shippers of ore containing 35 per cent and more of manganese, and of ore containing 10 to 35 per cent of manganese increased in 1924, but shipments of both grades decreased, indicating a considerable decline in the average total for each producer. Georgia had a larger number of shippers of each grade of manganese and manganiferous ores than any other State, although in shipments of high-grade ore (containing 35 per cent or more of manganese) it ranked eighth, and in shipments of the lower grades it ranked fifth and fourth, respectively. Most of the high-grade ore was from the Cartersville district, Bartow County, and from Fannin County, and most of the lower-grade ore was from the Cartersville district.

Montana.—In 1924 Montana shipped 63 per cent of the country's total shipments of high-grade manganese ore. Chemical ore has been shipped steadily from Philipsburg since the World War, but the large shipments of metallurgical ore in 1924 were apparently the result of the higher prices caused by the tariff on imports. Early in 1925 the mill of the Philipsburg Mining Co. burned. According to the Salt Lake Mining Review of April 15, 1925, the company planned to lease its mines to another company that had recently built a manganese mill at Philipsburg, rather than withhold production until a new mill could be built. The Trout Mining Co. began to erect a mill late in 1924 and put it into operation early in 1925.

Washington.— In 1924 for the first time Washington made an important production of manganese ore. The ore came from the Crescent mine, near Port Angeles, Clallam County. This mine was opened and equipped by Jamison and Peacock, of Duluth, Minn., in 1924 and began shipping in July. The ore which is shipped to the Atlantic seaboard for the manufacture of ferromanganese is high grade, and the shipment of 5,000 gross tons in 1924 contained 52.88 per cent of manganese, 0.83 per cent of iron, 8.80 per cent of silica, 0.050 per cent of phosphorus, and 1.50 per cent of alumina. Shipments are being continued in 1925 at about the same rate as in 1924. Because of the shipments by the Crescent mine prospecting for manganese has been active in the Olympic district. Several promising prospects have been located, and development work is progressing.

IMPORTS

Manganese ore imported into the United States, 1922–1924

[General imports]

Country	1922				1923		1924	
	Jan. 1–Sept. 21		Sept. 22–Dec. 31					
	Ore (gross tons)	Value	Manganese content (gross tons)	Value	Manganese content (gross tons)	Value	Manganese content (gross tons)	Value
Africa (British):								
South	5,998	$21,891						
West	22,701	106,223			27,965	$297,376	23,034	$266,216
Argentina					928	20,040		
Belgium			528	$18,956				
Brazil	234,598	2,025,505	40,595	469,938	88,036	1,454,790	54,938	1,392,536
Canada	60	2,208	67	3,619			60	3,222
Chile					789	16,772	1,178	37,858
China	2	46	1	67	1	55		
Cuba	12,568	89,677			[a]	137,016	[a]	347,874
England	448	18,242	1,093	74,429	287	36,375	5	209
Germany	41	3,259	52	5,131	146	14,654	48	5,659
Hongkong			1,243	28,677	20	1,020	278	8,838
India (British)	24,250	82,016	298	4,793	25,568	625,299	54,566	1,340,119
Java and Madura			205	10,250	6	369		
Mexico	500	10,000						
Netherlands					26	1,664	3,632	153,709
Oceania (French)					[b]	36		
Panama	[b]	19			400	5,300		
Russia in Europe			1,642	38,180	11,670	262,790	41,097	1,050,832
Turkey:								
In Europe	26,561	336,638	1,000	50,000	38,139	914,156	52,557	1,429,788
In Asia					3,005	86,798		
	327,727	2,695,724	46,724	704,040	[c] 196,986	3,874,510	[c] 231,393	6,036,860

[a] The imports from Cuba are recorded as 9,062 gross tons of ore in 1923 and as 23,065 tons in 1924; manganese content not shown.
[b] Less than 1 ton
[c] Exclusive of the manganese content of Cuban ores.

The change made by the Bureau of Foreign and Domestic Commerce in its method of reporting imports of manganese ore into the United States is described on page 90 of this report. In the above table imports are given for 1922, 1923, and 1924, with 1922 divided where the change was made, so that for January 1 through September 21, 1922, the figures represent the gross weight of manganese ore imported into the United States, and from September 22 on they represent only the manganese content of the ore imported. The values given for the entire period represent the value of the ore, hence they are comparable. Figures of the gross weight of ore imported after September 21, 1922, are not available, so the Bureau of Mines for the purpose of comparison with earlier years has roughly estimated the gross weight of imports for the entire year 1922 as 425,000 gross tons; for 1923, 419,000 tons; and for 1924, 505,000 tons. If it is assumed that the gross weight of manganese ore imported in 1924 was 505,000 gross tons, there were only three years, 1916, 1917, and 1920, in which the imports of manganese ore were larger.

According to the table, in 1924 Brazil furnished more manganese in ore than any other country, India the next largest amount, then Turkey, and then Russia. The imports are credited to the port of shipment, however, rather than to the country in which the ore orig-

inated, and it is most likely that the ore credited to European Turkey should be credited mostly to Russia. An article in Commerce Reports[4] states that the Chiatouri deposits exported 474,274 gross tons of manganese ore during the operating year October 1, 1923, to September 30, 1924, of which 40 per cent was exported to America. This percentage equals 189,710 tons. It is evident, therefore, that in 1924 more manganese ore came from Russia than from any other country.

MANGANIFEROUS ZINC RESIDUUM

Manganiferous zinc residuum containing 12 to 15 per cent of manganese and 40 per cent of iron was recovered, as in former years, from the roasted franklinite concentrates at Franklin Furnace, N. J., and was smelted to spiegeleisen.

Manganiferous residuum, from zinc roasting in the United States, shipped in 1918–1924, in gross tons

1918	146,796	1922	81,333
1919	80,418	1923	132,801
1920	133,602	1924	119,457
1921	12,627		

FERROMANGANESE AND SPIEGELEISEN

The firms that made or shipped ferromanganese and spiegeleisen in 1924 are listed below (f indicates ferromanganese; s, spiegeleisen):

(f) Anaconda Copper Mining Co., Great Falls, Mont.
(f) Bethlehem Steel Co., Sparrows Point, Md., and Lackawanna, N. Y.
(fs) Bethlehem Steel Co., Johnstown, Pa.
(f) Electro Metallurgical Co., Niagara Falls, N. Y.
(s) Jackson Iron & Steel Co., Jackson, Ohio.
(f) Jones & Laughlin Steel Corporation, Woodlawn, Pa.
(f) Lavino Furnace Co., Lebanon, Pa., and Reusens, Va.
(fs) Lavino Furnace Co., Marietta and Sheridan, Pa.
(s) New Jersey Zinc Co., Palmerton, Pa.
(f) Tennessee Coal, Iron & Railroad Co., Bessemer and Birmingham, Ala.
(f) United States Steel Corporation, Etna, Neville Island, and Pittsburgh, Pa.
(s) United States Steel Corporation, Etna, North Braddock, and Pittsburgh, Pa.

Manganese alloys imported into and made from domestic and imported ores in the United States, 1919–1924, in gross tons

	1919		1920		1921	
	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese
Ferromanganese:						
Imported	33,022	26,418	59,254	47,403	9,077	7,262
Domestic production [a]	185,893	120,163	294,603	209,496	104,129	79,319
From domestic ore [b]	62,188	36,234	42,815	27,900	10,838	7,419
From imported ore [b]	123,705	83,929	251,788	181,596	93,291	71,900
Total	218,915	146,581	353,857	256,899	113,206	86,581
Percentage of manganese as ferromanganese made from domestic ore		24.7		10.9		8.6
Number of plants making ferromanganese	19		20		12	
Spiegeleisen:						
Imported	27	5	5,234	1,047	307	61
Domestic production [a]	84,098	15,792	111,447	21,006	56,495	9,462
From domestic ore [b]	81,558	15,268	96,727	18,257	48,895	7,975
From imported ore [b]	2,540	524	14,720	2,749	7,600	1,487
Total	84,125	15,797	116,681	22,053	56,802	9,523

[4] Bureau of Foreign and Domestic Commerce, "Russian output and export of manganese ore", Comm. Repts., No. 6, 1925, p. 323.

Manganese alloys imported into and made from domestic and imported ores in the United States, 1919–1924, in gross tons—Continued

	1919		1920		1921	
	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese
Spiegeleisen—Continued						
Percentage of manganese as spiegeleisen made from domestic ore		96.7		82.8		83.7
Number of plants making spiegeleisen	11		10		6	
Total available supply of metallic manganese as alloys		162,378		278,952		96,104
Percentage of total manganese imported as alloys		16.3		17.4		7.6
Percentage of total manganese as ferromanganese made in the United States from imported ore		51.7		65.1		74.8
Percentage of total manganese as spiegeleisen made in the United States from imported ore		.3		1.0		1.6
Percentage of total manganese as ferromanganese made in the United States from domestic ore		22.3		10.0		7.7
Percentage of total manganese as spiegeleisen made in the United States from domestic ore		9.4		6.5		8.3
Percentage of total manganese as alloys made from domestic ore		31.7		16.5		16.0
Percentage of total manganese made and imported as spiegeleisen		9.7		7.9		9.9
Total open-hearth and Bessemer steel	34,220,256		41,554,982		19,605,740	

	1922		1923		1924	
	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese
Ferromanganese:						
Imported	100,725	80,580	113,833	91,066	56,588	45,270
Domestic production [a]	150,010	117,836	251,938	196,844	211,965	165,776
From domestic ore [b]	2,547	2,017	13,070	10,008	7,352	5,600
From imported ore [b]	147,463	115,819	238,868	186,836	204,613	160,176
Total	250,735	198,416	365,771	287,910	268,553	211,046
Percentage of manganese as ferromanganese made from domestic ore		1.0		3.5		2.7
Number of plants making ferromanganese	6		12		11	
Spiegeleisen:						
Imported	8,151	1,630	4,668	934	7,433	1,487
Domestic production [a]	72,974	11,668	129,683	20,410	107,067	17,731
From domestic ore [b]	70,374	11,365	126,424	20,026	103,617	17,306
From imported ore [b]	2,600	303	3,259	384	3,450	425
Total	81,125	13,298	134,351	21,344	114,500	19,218
Percentage of manganese as spiegeleisen made from domestic ore		85.5		93.8		90.1
Number of plants making spiegeleisen	4		7		6	
Total available supply of metallic manganese as alloys		211,714		309,254		230,264
Percentage of total manganese imported as alloys		38.9		29.8		20.3
Percentage of total manganese as ferromanganese made in the United States from imported ore		54.7		60.4		69.6
Percentage of total manganese as spiegeleisen made in the United States from imported ore		.1		.1		.2
Percentage of total manganese as ferromanganese made in the United States from domestic ore		.9		3.2		2.4
Percentage of total manganese as spiegeleisen made in the United States from domestic ore		5.4		6.5		7.5
Percentage of total manganese as alloys made from domestic ore		6.3		9.7		9.9
Percentage of total manganese made and imported as spiegeleisen		6.3		6.9		8.3
Total open-hearth and Bessemer steel	35,228,281		44,383,745		37,476,940	

[a] Quantity made.

[b] Partly estimated.

At a first glance the production of ferromanganese from domestic ores in 1923 seems out of proportion to the shipments of domestic ore. The accompanying table shows that 13,070 tons of ferromanganese was made from domestic ore in 1923. If the total domestic shipments of high-grade ore (31,500 tons) had been used in the manufacture of ferromanganese it would not have been enough to make the 13,070 tons, and of the total domestic shipments 62 per cent was chemical ore from Philipsburg. This seeming discrepancy, however, is due to the fact that furnaces used large quantities of ore accumulated during preceding years.

Ferromanganese and spiegeleisen shipped from furnaces in the United States, 1919–1924

Year	Ferromanganese		Spiegeleisen	
	Gross tons	Value	Gross tons	Value
1919	198,255	$27,093,816	90,855	$3,965,754
1920	[a] 276,594	41,840,690	163,672	5,289,049
1921	[a] 111,374	13,654,800	[b] 69,230	2,838,692
1922	[a] 161,612	10,673,638	70,253	2,162,836
1923	226,365	23,853,313	134,086	4,547,113
1924	[a] 232,821	23,533,668	76,179	2,354,731

[a] Includes a small quantity of silicomanganese.
[b] Includes a small quantity of silicospiegel.

Ferromanganese and spiegeleisen imported for consumption in the United States, 1919–1924

Year	Ferromanganese		Spiegeleisen	
	Gross tons	Value	Gross tons	Value
1919	33,022	$4,283,541	27	$1,018
1920	59,254	7,775,278	5,234	277,900
1921	9,077	888,419	307	10,472
1922 Jan. 1–Sept. 21	72,136	6,125,469	3,899	268,135
1922 Sept. 22–Dec. 31	[a] 22,871		4,252	
1923	[a] 91,066	8,357,023	4,668	165,791
1924	[a] 45,270	3,844,474	7,433	235,566

[a] Prior to Sept. 22, 1922, figures represent gross weight of the ferroalloy but since that date represent the manganese content of the ferroalloy.

The following table shows that the average contract prices of ferromanganese and of spiegeleisen by months for the last five years had a wide range. The ferromanganese prices are for material delivered at Pittsburgh; the spiegeleisen prices are for material at producers' furnaces. (See also fig. 1.) Prices on ferromanganese are based on 80 per cent of manganese; prices on spiegeleisen are based on 20 per cent of manganese. The prices on manganese ore are for material containing 50 per cent of manganese.

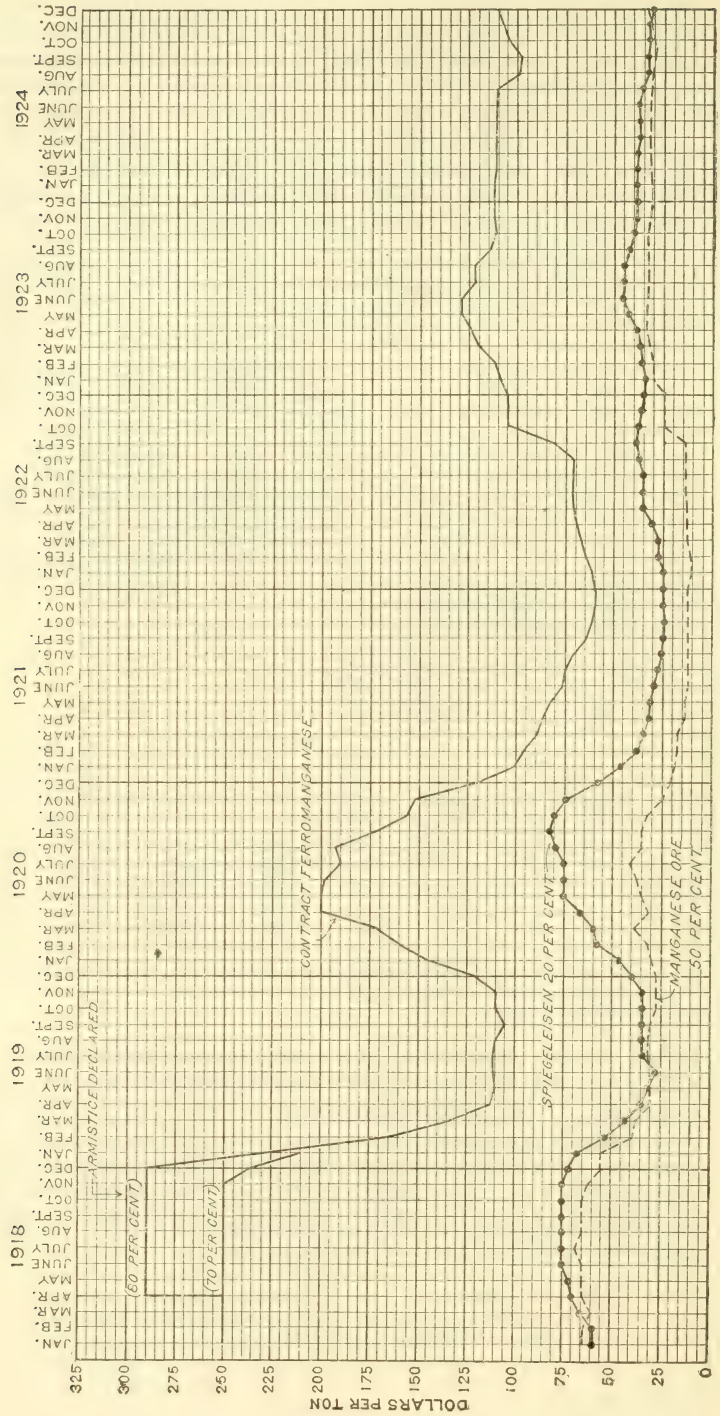

FIGURE 1.—Contract prices of ferromanganese, spiegeleisen, and manganese ore, 1918–1924

Prices per gross ton of ferromanganese, spiegeleisen, and manganese ore in the United States, 1920–1924 [a]

Month	Ferromanganese (80 per cent)					Spiegeleisen (20 per cent)				
	1920	1921	1922 [b]	1923 [b]	1924 [b]	1920	1921	1922	1923	1924
January	$146.00	$101.00	$61.90	$109.79	$113.79	$46.60	$46.25	$25.50	$34.90	$39.00
February	160.00	96.85	65.32	112.29	112.29	57.60	37.75	28.00	35.75	39.00
March	172.00	89.00	67.82	120.79	112.29	60.40	34.20	28.00	37.25	38.00
April	200.00	87.50	69.07	124.79	112.29	66.85	32.00	30.00	39.25	36.00
May	200.00	83.00	72.32	129.79	112.29	75.00	31.75	35.00	43.00	36.75
June	198.00	76.50	72.82	129.79	112.29	75.00	29.60	35.25	46.00	36.00
July	190.00	75.00	72.29	122.29	110.79	75.00	27.50	35.00	45.00	35.00
August	193.75	70.75	72.29	122.29	98.79	79.35	26.20	37.00	45.00	32.50
September	172.40	64.75	80.59	114.79	97.79	82.00	25.25	38.00	43.50	32.00
October	156.40	61.65	105.47	112.79	104.79	80.00	24.85	37.75	40.00	31.00
November	153.00	60.60	104.92	113.79	107.29	74.35	25.00	36.80	39.00	31.75
December	120.00	60.00	104.92	113.79	109.79	57.90	25.00	35.50	38.00	31.00

Month	Manganese ore (50 per cent)				
	1920	1921	1922 [c]	1923 [c]	1924 [c]
January	$30.00	$18.75	$10.50	$29.45	$31.20
February	38.75	17.50	11.00	29.45	32.70
March	38.75	17.25	12.50	31.70	32.20
April	32.25	14.00	12.75	33.20	32.20
May	35.00	14.00	12.75	32.70	32.20
June	37.50	12.50	13.25	32.95	31.70
July	42.25	12.50	13.50	32.95	30.70
August	35.00	12.50	13.75	32.95	30.20
September	35.00	12.50	14.35	31.70	30.20
October	32.75	12.50	25.50	31.70	30.20
November	25.00	12.50	25.50	31.70	31.70
December	21.25	12.00	25.50	31.70	32.20

[a] Iron Trade Review.

[b] Beginning with Sept. 22, 1922, a duty of 1⅞ cents a pound of contained manganese was placed on ferromanganese imports.

[c] Beginning with Sept. 22, 1922, a duty of 1 cent a pound was placed on the metallic content of imported manganese ore. This amounts to $11.20 a ton on 50 per cent ore.

ANTIMONY

By Frank C. Schrader

INTRODUCTION

The United States is dependent on three main classes of material as sources of antimony or its alloys or compounds—metallic antimony, liquated antimony sulphide, and antimony ore. Metallic antimony, known as antimony regulus, is imported from China, Japan, Mexico, and other countries, and during the World War was produced in small quantity in the United States from both foreign and domestic ores. The metallic antimony imported from Japan is derived mainly from the refining of Chinese ore or "crude." Liquated antimony sulphide, also known as "crude antimony," "needle antimony," and antimony matte, is imported in small quantity from China. Antimony ore is imported from China (direct or by way of Japan), Bolivia (by way of Chile and Peru), Mexico, and other countries, and small quantities of ore are at times produced in the western United States.

A fourth class of material which should also be mentioned is antimonial lead, carrying from 12 to 20 per cent of antimony. Any of the three classes of materials noted above may enter into this product, but it is derived mainly from lead ores, most of them of the antimonial variety.

The United States has always been dependent mainly on foreign sources for its supplies of antimony. China and Japan have been the principal contributors, although Mexico and Bolivia have also made considerable contributions. This dependence is in part a reflection of the higher wage scale in this country as compared with certain foreign countries, particularly China, but it is due primarily to our comparative poverty in antimony resources. However, new deposits are occasionally being found.

The examination in 1919 of a few of the deposits in Lander County, Nev., and in 1923 of deposits in Valley County, Idaho, indicates the presence of moderate reserves of ore at those localities. Newly discovered deposits are reported to occur in Camas County, Idaho, and in Kern, Los Angeles, and Tulare Counties, Calif.

Nearly all the antimony used in this country is consumed east of Mississippi River, mainly in the northeastern part of the United States, where most of the antimony using industries are situated. The chief market for antimony is in New York, but antimony is retailed in nearly every large city in this country by the makers of white-metal alloys, by smelters of secondary metals, and by general dealers in metals.

Antimony is a minor metal. Its market is widely recognized as one of the most unstable of the metal markets. The world's requirements for antimony are comparatively small, and when an

extra quantity is thrown on the market prices react sharply, the trade becomes so cautious that the market may disappear altogether, and production falls off rapidly.

ANTIMONY MARKET IN 1924[1]

The antimony market in 1924 was exceptionally unstable and subject to price fluctuations much more than that of any other metal. Prices ranged from a minimum of 8.325 cents per pound on May 13 to 17.50 cents on December 29–31, a total range of 9.175 cents as compared with 4 cents in 1923. The average price for the year was 10.77 cents per pound, compared with 7.81 cents per pound in 1923. The closing price of 17.50 cents compares with that of 9.75 cents in 1923 and an average price of 7.312 for the five pre-war years 1909–1913.

The primary cause of the unusual advance in price was the civil war in China in 1923 and 1924 which curtailed production, prolonged demoralization of the industry, and resulted in a general world-wide shortage of antimony. Contributing causes were speculative control of Chinese stocks and Chinese output, and a comparatively large demand from Europe because of the revival of European trade. Another cause was the fact that stocks were below normal. As imports throughout the year had been small, stocks in the hands of dealers and importers were so meager that stringency resulted. For instance, the imports of needle and regulus in 1924 were only 7,276 short tons, compared with 7,813 tons in 1923, 8,872 in 1922, and 10,577 in 1921.

Prices rose steadily, as stocks diminished and buyers began to realize the stress of the situation, until at the close of the year the metal was unobtainable at less than 17.50 cents a pound, the highest price reached since June, 1917, and only very small supplies were due to arrive in the future.[2] A shortsighted hand-to-mouth policy of consumers who bought without any anticipation of future needs was also a contributing cause of the rise in prices.[3] The amount of antimony entering any one commodity is so small that some consumers seem willing to pay any price that may be asked for the metal when they need it. An important development during the year has been the reappearance of Bolivian and Mexican antimony made possible by the relatively high prices.

The monthly prices for the year appear in the accompanying table.

Monthly prices of ordinary brands of antimony at New York during 1924, in cents per pound[a]

Month	Maximum	Minimum	Average	Month	Maximum	Minimum	Average
January	10.50	9.875	10.19	July	9.00	8.25	8.47
February	11.375	10.375	10.79	August	10.50	9.00	9.68
March	12.00	11.125	11.42	September	11.25	10.25	10.98
April	10.75	9.20	9.92	October	12.00	11.00	11.44
May	9.125	8.325	8.62	November	15.00	12.25	14.30
June	8.50	8.30	8.39	December	17.50	13.875	14.98

[a] American Metal Market.

[1] For a discussion of the market in earlier years the reader is referred to Mineral Resources for 1923.

[2] Masters, H. K., Antimony: Eng. and Min. Jour.–Press, vol. 119, Jan. 17, 1925, p. 92.

[3] Bandekow, K. Daily Metal Reporter. World's market reviews, international monthly section, Feb. 20, 1925, p. 10.

Following the general upward trend of the preceding December (from 8.75 to 10 cents), the price of antimony during January, 1924, advanced further. From 9.875 cents at the beginning of the month, the price rose in the latter part of the month to 10.50 cents. Consumers showed hesitancy in buying, and firm offers from China were scarce, as the antimony industry in that country was greatly disorganized by the civil war. During February the price continued to advance from 10.375 cents at the beginning of the month to 11.375 cents at the close. There were small imports of Chinese antimony from Europe and also of French antimony. As Chinese first-hand offerings were scarce at prices above the New York prices and the Chinese situation had affected the European market also, the American market subsisted essentially on previous imports.

The market advance culminated in March when the price of the metal reached 12 cents a pound. The final rise was attributed chiefly to reports that stocks and output in China were small and to consequent active trading between operators in parcels already afloat for this country. No supplies were offered in competition from Europe. As lower offerings finally came from China, the market weakened, a price of 11 cents prevailed for the last few days of the month, and some recent sales of spot Chinese antimony were made from this (American) market to Europe.

The decline that started in March continued through April, the price receding from 10.75 cents at the beginning of the month to 9.20 at the close. There was very little, if any, demand for the metal. During May consumers' demand for antimony continued very light. The price was 9.125 at the beginning of the month, but steadily declined to 8.325 cents by May 13, then rose to and remained at 8.75 for the next few days, and at the end of the month was 8.50 cents, with a downward tendency. The average price for the month was 8.62 cents. The rise in the middle of the month is attributed in part to European buying, but chiefly to speculative operations in China.

During June, particularly during most of the first and the last weeks, the price of antimony was about 8.375 cents. The lowest price reached was 8.30, which prevailed during the latter half of the second week. The highest price of the month, 8.50 cents, ruled from the 17th to the 21st. The average price for the month was 8.39. During the greater part of the month the Chinese market was about one-half cent higher than the New York parity, which resulted in shipments of small parcels from New York to Europe. The imports of regulus for consumption during the first six months of 1924 were 4,111 tons, compared with 2,421 tons in the same period in 1923. During the first half of July the market was dull. In the first week the price declined from 8.35 to 8.30, and during the second week and fore part of the third week the price was 8.25, the lowest of the month. From July 17 to 29 the price rose almost steadily to the maximum of 9 cents, a figure that was firmly maintained to the end of the month. The rise was attributed to floods in China and to speculative buying among domestic operators. There was also more buying for consumption in July than for several months before.

The advance that started late in July continued during August. From the minimum of 9 cents at the beginning of the month the

price gradually rose to the maximum of 10.50 by the 20th; it maintained this level till the 25th, then declined to 10.25 by the 31st. The rise was attributed to floods in the producing regions of China and to speculative buying there of the available Chinese supplies. The average price for the month was 9.68 cents. As a result of the chaotic conditions in China, the price of antimony continued to advance in September, rising from the minimum of 10.25 cents at the beginning of the month to the maximum of 11.25 by the 19th, holding this high level till the 26th, and then declining to 11.125 cents by the end of the month. The average price for the month was 10.98 cents. The lower prices here as compared with those in China were due to slack demand by consumers. European prices advanced correspondingly with those in China.

During October the price advanced gradually from the minimum of 11 cents a pound at the beginning of the month to the maximum of 12 cents at the close. The advance was due to higher prices in China when speculators bought up stocks. The average price for the month was 11.44 cents. In November the price rose from 12.25 cents on November 3, the minimum for the month, to the maximum of 15 cents—reached on the 13th and approximately maintained till the 20th—then gradually declined to 14.50 by the 28th. The average price for the month was 14.30 cents. The prices in China remained generally higher than the equivalent New York prices. A few small shipments were received from Europe and some Bolivian ore was shipped for smelting in this country. The average price of antimony in December was 14.98 cents. The advance during the month was 3.625 cents, compared with that of 2.75 cents for November. The opening, and the minimum, price of the month was 13.875 cents. With slight fluctuations the price advanced to 17.50, the maximum for the month, by December 29 and remained there till the close of the year.

In the technology of antimony the new process for refining antimonial lead, developed by H. Harris, of London, continues to be the latest important development. By this process 99 per cent of the antimony content is recoverable from the lead in a form easily reduced to the metallic state.[4] Although use of this process will probably contribute to the world's output of metallic antimony, it is not likely to affect the United States materially, for this country has use for practically all the antimonial lead it produces.

USES

METAL

Antimony was much more extensively used at one time than it is now. It was brought into great prominence by the World War on account of the large demand for it in the manufacture of ammunition, particularly bullets and shrapnel, in which it is employed as a hardening agent. Its peace uses are many, but only a few require large quantities of the metal, and although its war-time production amounted to nearly 82,000 metric tons a year, it yet remained a

[4] Mining and Metallurgy, April, 1924, p. 187; June, 1924, p. 299.

minor metal. Its field of uses, however, exclusive of the abnormal war demand, is widening, and the consumption is increasing.

Metallic antimony unalloyed has a few industrial uses. As a pigment in the form of fine powder, known as "antimony black" and "iron black," it is used for bronzing metals and plaster casts. For producing the appearance of polished steel on articles made of papier-mâché or pottery it is precipitated by the action of metallic zinc on an acid solution of antimony salts. The chief use of antimony is in alloy with other metals. Antimony is a standard constituent of white-metal alloys of low melting point, such as type metal, britannia metal, and stereotype metal. It alloys readily with most heavy metals, and the alloy is harder than either of the two pure metals. Most of these alloys possess the property of slight expansion on solidifying. The metals with which antimony is most commonly alloyed are lead, tin, and copper.

Type metal is an alloy of lead, antimony, tin, and copper; babbitt, antifriction, or bearing metal is usually an alloy of antimony, tin, and copper. The largest use is in babbitt metal, and the next largest in coffin trimmings, which are made of antimonial lead, as are also automobile flower vases. The metal is also used extensively in making battery plates for storage batteries used in automobiles, airplanes, and radio apparatus. This use, in an alloy of about 6 per cent antimony and 94 per cent lead, is increasing enormously.

Britannia metal, also known as white metal, is an alloy of antimony, tin, and copper, with some zinc and rarely small quantities of other metals. It is used in making cheap domestic tableware. Antimony alloys find minor utilization in toys, cable coverings, and siphon tops. Its use in cable covers is increasing.

Small quantities of antimony enter into certain brasses and aluminum alloys. Lead-antimony alloy, or "hard lead," is used in making acid-resisting valves. Recently it has been used also in casting metal taps, etc., in which the eutectic mixture of the two metals, 87 per cent lead and 13 per cent antimony, is used, as it gives the best results and presents the least difficulty due to shrinkage or segregation of the metal.[5] In alloy with tin, lead, cadmium, and bismuth, antimony is employed in making fuse rods or blocks for use in temperature indicators for bearings.

Lead-antimony alloys containing about 8 per cent antimony are being used in large quantities in sheet form as sheet "hard lead," which is decidedly harder than sheet lead. Sheet hard lead has been on the market for several years, is becoming quite popular, and to some extent is replacing ordinary sheet lead for roofing material, gutters, and leaders, in the chemical industries, for casting chemical tanks, and in electrolytic refining tanks.[6]

Sheet hard lead is employed also in the manufacture of a new product called "crawl-proof lead." This is sheet lead reinforced with antimonial lead and is used successfully where antimonial lead is not sufficiently strong or rigid. Antimonial lead and "crawl-proof lead" are free from the undesirable properties known as permanent elongation, stretching or expansion, sagging, creeping, and crawling.[6]

[5] Metal Industry, vol. 21, November, 1923, p. 453.
[6] Metal Industry, vol. 22, January, 1924.

The percentages of antimony in the chief alloys of which antimony is an important constituent are about as follows:

	Per cent antimony		Per cent antimony
Battery plates	4–12	Monotype and "small type"	16–24
Bearing metals	5–18	Sheet "hard lead"	8
Britannia metals	5–16	Shrapnel	12–13
Coffin trimmings	12–14	Taps	13
Linotype	11–12	Type metal	12–18

OXIDES

The antimony oxides are used chiefly for making white enamel and glass, the oxides and sulphides as coloring agents and pigments, and the sulphides in vulcanizing rubber. The oxide is used also in the manufacture of insecticide powder and in proportions up to 1½ per cent in the manufacture of litharge. It is used in making colloidal products employed in medicine and surgery, in tanning, in the preparation of cosmetics, for the protection of plants, and for the impregnation of wood fabrics.

In making opaque white enamel and other sanitary ware, the tetraoxide (Sb_2O_4) is mainly used. For this purpose the antimony oxides are employed as a substitute for tin oxide. In the manufacture of glass the trioxide is mainly used as a coloring agent, as it is more fusible than the tetraoxide and does not impart opacity to the glass.

During the last few years use of the white oxide in paint has become extensive. The chief product, which is put out by Cookson & Co. in England, is known by the trade name "timonox." Large quantities of it are imported into this country by paint and varnish houses. An apparently similar oxide, known as "antox," is produced in considerable quantities in Australia. According to recent investigations of the Paint Manufacturers' Association of the United States, antimony oxide as a paint pigment compares favorably with the well-known pigments lithopone and titanox and is nontoxic.[7]

Recently antimony oxide recovered from fumes at the Selby smelter has been used in making a gray paint that promises to be an excellent substitute for lead paint on oil tanks, water tanks, and similar work. Antimony oxide mixes readily and smoothly with linseed oil, forming a coherent paint that is very satisfactorily applied. It is not much more expensive than zinc oxide.

Antimonate of lead containing an excess of lead oxide, known as "Naples yellow," is used in oil paints and in the glass and ceramic industries. Tartar emetic (double tartrate of antimony and potassium), antimony trioxide, and antimony fluoride are employed as mordants in dyeing. Tartar emetic and antimony trioxide are also employed medicinally, and tartar emetic is used in fixing tannin. Antimonate of soda is used in making enamel ware. In a new use of the oxide it is combined with alkaline zinc to produce imitations of antique silver finishes in art, such as the polychrome work of early days, also antique silver trimmings on furniture.[8]

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[7] Gardner, H. A., Titanox, antimony oxide, and lithopone: Paint Mfrs. Assoc. Circ. 199, 1924, pp. 260–264.

[8] Metal Industry, vol. 21, No. 3, March, 1923, p. 107.

SULPHIDES AND OTHER COMPOUNDS

The red sulphides of antimony are used in vulcanizing and coloring rubber, keratin buttons, etc. red, and also in paint pigments. The quantity used for these purposes has greatly increased in the last few years. Formerly the natural antimony trisulphide, stibnite, entered into the composition of safety matches or of the compound which was put on the match box. "Black antimony," or "sugar of antimony" (Sb_2S_3), is used in making furniture polish and varnish suitable for violins and similar articles. Pulverized antimony sulphide, or liquated stibnite, is almost universally used in the manufacture of fireworks and as a constituent of primers in shells and cartridges. It is also used in the charge of shells, to produce on explosion a dense white smoke, which is of service in range finding and as a screen in warfare.

Antimony chloride ($SbCl_3$) is used in the preparation of fireproof and waterproof creosote, pitch, tar, and asphalt preservatives of fibrous materials, such as wood, paper, and textile fabrics.

Fluoride of antimony and soda is used as a mordant in dyeing textiles.

SUBSTITUTES

There are a number of other metals or materials that will harden lead and therefore can be used as a substitute for antimony in lead alloys, but antimony is cheaper than most of the substitutes, and as the antimony deposits of the world are abundant in proportion to the consumption of the ore, the course of industry seems more likely to develop new uses for antimony.

Of the 10 or more known substitutes for antimony, the best found in recent years is a combination of calcium and barium, said to be used with excellent results by the United Lead Co. in the hardening of lead.[9] The process is electrolytic, and calcium-barium-lead alloys are now made on an extensive scale.

"Ulco" metal or "Ulco lead" is simply pig lead treated in an electric furnace with a small percentage of other material (as barium?), which produces a hardness in the lead superior to that imparted by antimony, but according to the United Lead Co. it makes the lead 10 per cent heavier, or too heavy for shrapnel metal, in which 12½ per cent of antimony is customarily used.

Bismuth may be used as a substitute for antimony, but its cost is much higher.

Tin oxide and other white oxides may be used as a substitute for antimony compounds in paint and in general wherever such compounds are used for coloring.

As excellent primers have been prepared from pure lead sulphide and pure iron sulphide, it is probable that other sulphides could, if necessary, be substituted for antimony sulphide as a constituent of primers in shells and cartridges.

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[9] Chem. and Met. Eng., Dec. 28, 1921, p. 1181; Min. Mag. (London), vol. 26, 1922, p. 127.

DOMESTIC PRODUCTION

Mine production of antimony ores in the United States, 1915–1924, in short tons [a]

Year	Total	Antimony content	Year	Total	Antimony content
1915	5,000	2,100	1922	20	4
1916	4,500	1,770	1923	40	10
1917	1,060	390	1924	113	33
1918	190	50			

[a] Mine production negligible prior to 1915, and no production from 1919 to 1921.

Only two smelters reported a small production (all from foreign ores) in 1919 and one in 1920, and the Bureau of Mines is not at liberty to publish the figures. Besides the small quantity of metallic antimony, there was also produced from foreign and domestic ores a relatively large quantity of oxides and other salts, the figures for which the bureau is not at liberty to publish. There was no smelter production in 1921 to 1924.

SMELTER PRODUCTION OF ANTIMONIAL LEAD

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1919–1924

Year	Short tons	Antimony content	
		Short tons	Value [a]
1919	13,874	1,943	$319,000
1920	12,535	2,033	345,000
1921	10,064	1,589	158,000
1922	8,075	1,441	156,000
1923	14,190	2,170	338,500
1924	20,787	2,763	596,800

[a] Calculated on basis of average yearly price for ordinary brands of antimony as given by American Metal Market.

The main consumers of antimonial lead are the storage-battery makers. The battery metal that they produce from this antimonial lead contains 4 to 12 per cent of antimony.

The value of antimonial lead is approximately $5 less per short ton than the value of the lead content plus the value of the antimony content.

RECOVERY OF SECONDARY ANTIMONY

During 1924 (according to J. P. Dunlop) 9,404 short tons of antimony, 15 per cent more than the total antimony imports and valued at $2,025,600, was recovered from old alloys, scrap, and dross. Nearly all of it was recovered in the form of alloys, and only a small quantity as metallic antimony; 944 tons, or 10 per cent, was recovered from antimonial lead scrap treated at regular smelters, and

8,460 tons, or 90 per cent, was recovered as metal and in alloys reported by secondary smelters.

Secondary antimony and antimony content of secondary alloys, recovered from old alloys, scrap, and dross in the United States, 1919–1924

Year	Short tons	Value [a]	Year	Short tons	Value [a]
1919	4,399	$717,900	1922	7,090	$765,700
1920	5,600	938,560	1923	8,021	1,252,800
1921	4,720	464,400	1924	9,404	2,025,600

[a] Calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

The chief materials refined or resmelted that contained antimony as an alloy were hard-lead drosses, babbitt, battery plates, solder, pewter, and type metal. Antimony used in the rubber, glass, enamel, paint, and ceramic industries is not recoverable.

IMPORTS AND EXPORTS

The accompanying statistics are compiled from the records of the Bureau of Foreign and Domestic Commerce. The imports are reported as (1) imports for consumption, including merchandise entered for immediate consumption or withdrawn from bonded warehouse for consumption, and (2) total or general imports. Only general imports are listed by countries of origin.

Antimony imported for consumption in the United States, 1919–1924

Year	Antimony ore [a]			Liquated antimony sulphide [b]		Metallic antimony [c]		Antimony oxides and other compounds [d]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1919	993	409	$54,477	278	$19,202	7,159	$1,021,587	126	$9,501
1920	1,709	682	70,285	1,375	123,902	9,817	1,216,376	298	25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558
1922				689	40,108	9,344	659,242	379	65,538
1923	(e)	1,047	44,721	835	64,493	6,763	641,804	2,277	288,206
1924	(e)	899	62,999	558	52,393	6,778	840,434	1,207	190,252

[a] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[b] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead"; also as "needle or liquated antimony."
[c] Classified in tariff classification as "Antimony regulus or metal."
[d] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."
[e] Figures not available.

Antimony imported into the United States, 1923–24 [a]

[General imports].

Country	Antimony content of ore		Antimony metal [b]	
	Pounds	Value	Pounds	Value
1923				
Australia	113,864	$4,901		
Belgium			38,715	$2,420
Bolivia [c]	176,368	3,937		
Canada			55,740	3,848
Chile [c]	1,169,784	25,644		
China [d]			13,185,898	558,771
England	1,340	102	1,410,198	99,927
France	111,026	1,020		
Germany	1,800	906	750,555	44,953
Hongkong [d]			73,762	3,385
Italy			60	9
Japan [d]			56,000	2,074
Mexico	519,913	8,211		
Straits Settlements			56,000	2,682
	2,094,095	44,721	15,626,928	718,069
1924				
Africa (Portuguese) [e]	2,225	150		
Argentina	96,320	1,424		
Australia	217,280	9,171	89,600	6,637
Belgium			121,660	8,142
Canada			10,248	1,252
Chile [c]	1,094,468	46,162		
China [d]			11,662,148	667,655
England			1,095,236	100,838
France	2,400	125	227,988	16,599
Germany			544,516	46,736
Hongkong [d]			224	12
Italy			213,990	13,886
Japan [d]			145,599	9,405
Mexico	333,996	4,373	440,921	29,756
Peru	51,261	1,594		
	1,797,950	62,999	14,552,130	900,918

[a] Includes large quantities of antimony metal that went into bonded warehouse and that are not included in the table of imports for consumption.

[b] Includes small quantities of liquated antimony sulphide, known in the trade as "crude antimony," "antimony matte," or "needle antimony."

[c] Imports credited to Chile originated mainly in Bolivia.

[d] Nearly all the imports of antimony ore and metal from Hongkong and Japan are of Chinese origin. Some of the material credited to other countries is possibly also of Chinese origin, having been transshipped in a foreign port.

[e] Angola and other Portuguese possessions on the West coast of Africa.

The total general imports of 16,350,080 pounds in 1924 show a decrease of 8 per cent in quantity and an increase of 26 per cent in value as compared with 1923. They were derived from 15 different countries as compared with 14 countries in 1923. The additional countries contributing were Argentina, Peru, and Portuguese West Africa. Bolivia and Straits Settlements dropped out.

Seventy-one per cent of the imports (in 1924) came from China; 7 per cent each from England and Chile. These countries were followed by Mexico with nearly 5 per cent and Germany with 3 per cent.

Of the total imports 11 per cent came as ore, 61 per cent of which was from Chile, whose shipments were all ore, as were also those of Argentina, Peru, and Portuguese West Africa. The imports of antimony metal amounted to nearly 630,000 pounds in January and 1,392,000 in December. They were heaviest during the early part of

the year and reached a maximum of 2,850,874 pounds in February and a minimum of 164,444 pounds in August.

For many years large quantities of antimonial lead have been imported into the United States as type metal, for which it is largely used, but from 1912 to 1918 these imports declined. In 1919, however, after the World War had ended, they increased to 6,697 tons, and they continued to increase each succeeding year until in 1922 they amounted to 22,448 tons. They came mostly from Canada and consisted largely of shrapnel lead, which contains about the same percentage of antimony as type metal.

Type metal imported for consumption in the United States, 1920–1924

Year	Type metal		Assumed antimony content		Year	Type metal		Assumed antimony content	
	Short tons	Value	Short tons	Percentage		Short tons	Value	Short tons	Percentage
1920	14,944	$1,349,495	2,063	13.8	1923	[a] 3,677	[a] $431,610	[b]	[b]
1921	19,485	1,191,553	4,132	21.2	1924	[a] 644	[a] 100,367	[b]	[b]
1922	22,448	1,120,814	5,476	24.4					

[a] Lead content only. Figures for gross weight not available.
[b] Data not available.

The customs returns give only the lead content of imported type metal, and the figures given above are based on the assumption that the remainder is practically all antimony, but this assumption is arbitrary, for imported type metal contains as much as 2 per cent of impurities, such as iron, arsenic, and copper. The antimony content is therefore probably too large by some quantity less than or approximately equal to 2 per cent of the total quantity of type metal, and the correct percentage is correspondingly lower.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1920–1924 [a]

Year	Pounds	Value	Year	Pounds	Value
1920	896,034	$51,607	1923	15,958	$1,047
1921	299,776	15,741	1924	279,920	14,441
1922	37,218	1,548			

[a] During 1922 there was also exported, mainly to Canada, 224,610 pounds of regulus or metal of domestic manufacture, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, antimony manufactured in the United States from foreign ores and exported would also be classed as domestic exports. Similar exports for 1923 and 1924 are not shown.

STOCKS

Stocks of antimony in 1924 were not large. The monthly average stocks of regulus and matte remaining in bonded warehouses during 1924, according to the Bureau of Foreign and Domestic Commerce, amounted to 1,493,650 pounds as compared with 1,216,460 pounds in 1923.

Except in March and during the last quarter of the year the monthly stocks considerably exceeded a million pounds. They were

heaviest during the middle part of the year and reached a maximum of 2,683,298 pounds in July; they averaged 2,441,706 pounds for June, July, and August. From 1,895,214 in September they decreased almost steadily to 683,962 pounds in December and at the end of the year. This figure was the minimum for any month of the year and compared with 1,375,589 pounds at the end of the year 1923. Figure 1 gives a general comparison for the last four years.

PRICES

The average yearly New York quotations for the ordinary grades of metallic antimony for the last 30 years, according to the American Metal Market, are as follows:

Average New York quotations for metallic antimony, 1895–1924, in cents per pound

1895–1904	7.53	1916	25.33
1905–1907	13.72	1917	20.73
1908	7.80	1918	12.55
1909	7.35	1919	8.16
1910	7.27	1920	8.38
1911	7.48	1921	4.92
1912	7.63	1922	5.42
1913	7.43	1923	7.81
1914	8.53	1924	10.77
1915	29.52		

WORLD'S PRODUCTION

Because of the various and not strictly comparable terms in which production is reported in most foreign countries, it is impossible to give more than a rough comparison between the principal important producers. As nearly as can be estimated the yearly production of antimony ore, for which even approximately complete statistics are not available, amounts to about 20,000 metric tons of recoverable antimony, exclusive of the antimony content of antimonial lead ores. Nearly all of the world's production is made by 10 of the 26 producing countries listed.

From 1908 to the outbreak of the World War in 1914 more than 50 per cent, and since 1914 more than 60 per cent of the world's production of antimony has come from China. At the time China's maximum production was reached (42,800 tons in 1916) the production of all other countries combined was nearly as much, but during 1922, despite a greatly reduced output due to the very low prices, China produced at least 80 per cent of all antimony ore mined in the world, and in 1923 China's output was again about 80 per cent of the world's production.

The following table shows the world's production for the years 1917–1924 so far as reasonably approximate data are available. An attempt has been made to reduce all statistics of production to a common basis—that of the recoverable metal content of the ore produced. The figures do not imply that this quantity of metallic antimony was actually produced. A part of the ore goes directly into the manufacture of oxides and other salts, and in recent years lead smelters have purchased antimony ore which they smelted with lead ore for the direct production of antimonial lead. On the

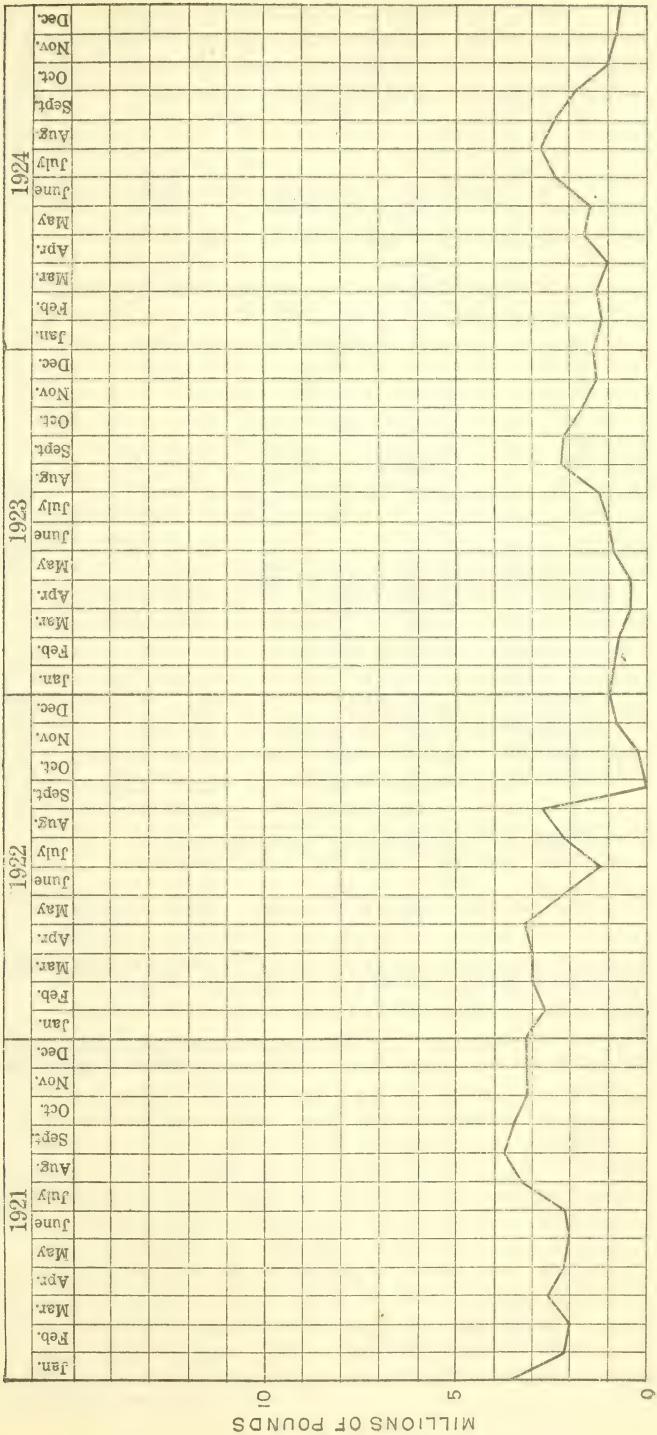

FIGURE 2.—Stocks of metallic antimony in bonded warehouses at end of each month, 1921–1924

other hand, a small quantity of antimony is produced by lead refineries, and the antimony content of antimonial lead ores is not included in the table because sufficient data are not available.

It is evident that the world's present capacity to produce antimony far exceeds the normal demand. New deposits of antimony ore are being found from time to time. One was recently discovered at Gresford, near Paterson, New South Wales, one in Camas County, Idaho, and others in Kern, Los Angeles, and Tulare Counties, Calif.

World's production of antimony, 1917–1924, in metric tons

[Approximate recoverable metal content of ore produced, exclusive of antimonial lead ores]

Country	1917	1918	1919	1920	1921	1922	1923	1924
North America:								
Canada	87	[a] 7	[a] 14					
Mexico	2,647	3,279	471	623	45	464	490	775
United States	310	45				4	8	24
South America:								
Argentina [b]	650	360	27	50	(c)	(c)	(c)	(c)
Bolivia [a]	10,288	3,010	105	484	282	185	312	621
Peru [a]	433	155	30	7	7			(c)
Europe:								
Austria	38		1			139	62	1
Czechoslovakia	[d]	(c)	153	330	384	100	453	1,066
France	2,354	1,329	998	1,130	1,276	834	437	674
Greece			55	46				
Hungary	406	(c)	66	93			(c)	(c)
Italy	689	404	10	187	76	146	271	372
Portugal							8	14
Spain	148	22					25	
Yugoslavia	725	(c)	(c)	(c)	(c)	(c)	131	414
Asia:								
China [a]	28,450	15,597	7,721	13,001	14,658	13,858	14,244	11,410
India, British	61		2		1			
Indo-China	[a] 800	(c)	(c)	(c)	(c)	(c)	(c)	
Japan	1,606	95	1					
Turkey (Asia Minor)	[e] 400	[e] 400	[e] 400	[e] 400	[e] 400	[e] 400	[e] 400	[e] 400
Africa:								
Algeria [a]	4,550	2,218	723	1,000	103	579	500	905
Nigeria [a]			[f]	[f]	[f]	[f]	[f]	(c)
Rhodesia, Southern	3	3		2				
Union of South Africa	232	38	10					
Oceania:								
Australia—								
New South Wales	150	143	70	81	50			
Victoria	1,045	509	491	406	141	605	421	130

[a] Exports.

[b] Railway shipments. A large part of the shipments reported are probably of Bolivian origin and therefore may duplicate in part the quantities shown for Bolivia.

[c] Data not available.

[d] Included under Austria and Hungary.

[e] Estimated.

[f] Less than 1 ton. The estimated recoverable metal content of ores exported was as follows: 1919, 169 kilograms; 1920, 178 kilograms; 1921, 74 kilograms; 1922, 190 kilograms; 1923, figures not given.

SECONDARY METALS

By J. P. Dunlop[1]

INTRODUCTION

SCOPE OF REPORT

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses, and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The figures furnished by producers cover seven metals—secondary copper, zinc, lead, tin, antimony, aluminum, and nickel, and are supplemental to those on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential addition to the figures given in the general reports on the primary metals.

RECOVERY OF WASTE MATERIAL

The collection of waste material is an established branch of industry. It involves the collection, sorting, and shipment of waste having an estimated value of more than a billion dollars yearly; it has advanced in honesty, efficiency, and usefulness, and it is growing rapidly. Better-equipped plants handle the material, and technical methods of handling and using waste are rapidly superseding ignorance and guesswork.

Few people realize the ramifications of the trade in waste materials; few realize its importance in keeping down costs of many products, such as containers; few realize how the prices of metals and of many other commodities would soar if waste products did not supplement the stocks of primary materials. The advertisements in trade papers devoted to waste materials indicate that there is a market for nearly every variety of waste, and yet adequate statistics on quantity and value are available for only a few classes of it. This report covers only a part of the waste metals of certain classes, and only a very small part of the wide variety of waste materials that are marketed.

[1]Figures of imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Among other wastes offered for sale are iron and steel, rags, jute and cotton bags, paper sacks, hair, feathers, picture films, old hats, bones, broken glass, paper of all kinds, barrels, rope, roofing, shoes, scrap leather, celluloid, canvas, tubes, casings, haircloth, carpets, etc. The value of some of the varieties of waste aggregates millions of dollars, and would be much greater if the cost of collecting, sorting, and shipping were not so high.

Shipments of metallic waste from country districts have been comparatively small in recent years, although they increased a little in 1924, and offerings of scrap metal by the War and Navy Departments of the United States decreased in 1924 to less than normal quantities; consequently manufacturing plants, foundries, and railways supplied nearly all the waste metals recovered. The abundant postwar supply of scrap metals (especially brass), which had markedly affected the consumption of new metals, has reached the consumer. It is notable also that some European metal dealers have established American agencies for the purchase of scrap and drosses. In 1924 exports of waste metals from the United States increased, imports from Europe declined, and exports to Europe exceeded the imports. In some classes of old metals and alloys the competition between eastern refineries and smelters and the foreign buyers was very keen and prices were high.

Buyers and sorters of waste products must possess considerable ability in handling, sorting, shipping, and selling. The variety of waste metals and the differences in composition are bewildering. The grades and the character of the materials used by consumers vary not only with officially adopted classifications but with individual preferences and requirements. Rejection of shipments is costly, and if market conditions become unfavorable during transit advantage is freely taken of small differences in specifications which are ignored under normal conditions. Care has to be exercised in taking advantage of freight classifications in order to get the lowest rates. Much of the waste from country collections requires careful sorting, and this is not easy to do by visual examination alone when there are so many alloys used in various products. Lower prices primarily are paid for small, unsorted lots of waste metal than for scrap metals that have been carefully sorted and graded at large plants. Every year there is an increased number of foundries and metal-working establishments that carefully segregate all waste made at their plants. The expense of doing this is quickly returned in the better prices obtained for waste metals sold.

The following article on salvaging scrap is quoted from The Metal Industry, April, 1925, page 156:

> In an interesting article by R. C. Daniels, manager of the salvage and by-products department of the Ternstedt Manufacturing Co., of the General Motors Corporation, published in Factory for April, 1925, the methods of salvaging scrap are discussed at considerable length. The problem, which is present, of course, in every factory, is viewed from the angle of methods of disposal rather than methods of recovery.
>
> The equipment required is of the simplest type, consisting only of a clean floor for sorting, a platform scale for weighing, and bins for storage. In many cases, however, it may be necessary to add a magnetic separator to remove iron and steel from the other metals.
>
> Once the sorting has been accomplished, the question is only of the avenue of disposal to use. These avenues are listed as follows: (1) The copper and brass rolling mill, (2) the large smelter and refiner, (3) the local brass foundry, (4) the broker, (5) the local dealer who operates a warehouse, and (6) the junkman.

The functions of these various agencies are quite distinct. A rolling mill will probably pay the highest price, but will take only certain classes of scrap, preferably its own, this of course depending upon the type of product of the particular rolling mill. The large smelter also demands carload lots, but will take anything, whether it is sorted or not. However, clean, classified materials command a much better price. A local brass founder will often accept certain selected grades of material, and it will sometimes pay to sell directly to him in small lots. The price obtainable depends entirely upon the market price of ingots.

The broker will buy anything at any time. He has always enough connections to be able to dispose of his material. Of course, his profit will come out of the seller's pocket, but he is often a great enough convenience to make him worth while. The local dealer is the small-lot man, the logical agent to handle materials running a few hundred pounds or perhaps a few tons. He stores these materials, after doing the necessary sorting, and sells to the smelter in carload lots. The junk dealer is very seldom the proper agency for a manufacturing plant, but is rather a collector of a few pounds here and there, which he sells to the dealer.

Prices obtainable range from 70 per cent of the copper in the scrap in clean clippings down to 12 per cent for brass grindings. It is seldom possible for the seller to do anything but accept the price set by his local channels of distribution, since these prices are dictated by market conditions. However, if he is a large shipper he can get competitive bids from smelters and perhaps mills.

The primary considerations in the disposal of scrap are the accuracy and cleanliness with which it is sorted and classified. Clean metal will always command enough of a premium to pay for sorting it if the quantities are sufficient. The best method is to sort and classify at the actual sources of the scrap, as far as possible preventing contamination.

In his article on "The economics of the copper, brass, and nickel-silver industries," read before the Empire Mining and Metallurgical Congress at the British Empire Exhibition in 1924, George W. Mullens said: "Nonferrous metals, generally speaking, do not disappear in use; they are reclaimable as scrap. This limits the price of new metals and also affects processes of production."

The chapters on secondary metals in Mineral Resources for 1918 and 1919 contain much information regarding the collection of waste material. Various trade papers, such as the Waste Trade Journal, Daily Metal Trade, Brass World, American Metal Market, Foundry, Iron Age, Iron Trade Review, Metal Industry, and Daily Metal Reporter, also contain valuable information relating to prices and marketing of scrap metal and drosses and technical information relating to the proper use of old metals. Some idea of the questions to which replies are given by technical and trade papers are set forth in a statistical survey of difficulties encountered by nonferrous foundries over a period of years, by Adolph Bregman, published in Metal Industry, July, 1922, page 269.

CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the metal division of the National Association of Waste Material Dealers (Inc.) (Times Building, New York, N. Y.) and changed from time to time as is found desirable has become the standard with both dealers and manufacturers all over the United States. The latest classification (Circular H), which is effective from July 1, 1925, made numerous changes in the standard classification of old metals. Many of the changes were to meet difficulties that have resulted from the large exports of red and yellow brass scrap. These changes are important, and manufacturers, waste-metal dealers, shippers, and consumers should carefully peruse the new classifications, especially sections 9, 10, 11, 12, and 15, and the new regulations, as to what constitutes a good delivery of certain grades of scrap, as set forth in section 1 (*i*) and (*j*).

Standard classification for old metals, effective from July 1, 1925

1. Delivery:
   (*a*) Delivery of more or less on the specified quantity up to 2½ per cent is permissible.
   (*b*) If the term "about" is used it is understood that 5 per cent, more or less, of the quantity may be delivered.
   (*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages, the arbitration committee of the National Association of Waste Material Dealers (Inc.), appointed for this purpose, to determine the amount of such damages.
   (*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to the arbitration committee of the National Association of Waste Material Dealers (Inc.), to be appointed for that purpose.
   (*e*) A contract for a carload, unless otherwise agreed upon, shall mean the minimum quantity recognized by the official classification tariff of the district in which the seller is located.
   (*f*) A ton shall be understood to be 2,000 pounds, unless otherwise specified.
   (*g*) If through embargo a delivery can not be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.
   (*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn weigher shall be employed, and the party most in error must pay the costs of handling and weighing.
   (*i*) In items below where it is provided that one or more grades shall be included, it is understood that all or any of those grades shall be considered a proper delivery.
   (*j*) When material is such that it can be sorted by hand, consignees can not reject the entire shipment if the percentage of rejection does not exceed 10 per cent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.
2. Heavy copper:
   This shall consist of copper not less than one-sixteenth inch thick and may include trolley wire, heavy field wire, heavy armature wire that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.
3. No. 1 copper wire:
   To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gage; to be free from burnt copper wire which is brittle and all foreign substances.
4. No. 2 copper wire:
   To consist of miscellaneous clean copper wire such as of necessity would be taken out of the heavy copper and the No. 1 copper wire, but to be free of hair and burnt wire which is brittle.
5. Light copper:
   Shall consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper, and similar copper, free from radiators, brass, lead, and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.
6. Composition or red brass:
   Shall consist of red scrap brass, valves, machinery bearings, and other parts of machinery, including miscellaneous castings made of copper, tin, zinc, and/or lead; no piece to measure more than 12 inches over any one part; not to weigh over 60 pounds; to be free of aluminum and manganese, also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots, and burned brass.
7. Railroad bearing:
   Shall consist of railroad boxes or car-journal bearings; must be old standard used scrap, free of yellow boxes, also iron-backed boxes, and must be free of babbitt; also free of excessive grease and dirt.

8. Cocks and faucets:
   To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.
9. Heavy yellow brass:
   Shall consist of heavy brass castings, rolled brass, rod brass ends, brass screws, and tinned or nickel-plated brass tubing; to be free of iron and dirt, and must be in pieces not too large for crucibles; no piece to measure more than 12 inches over any one part; must be free of manganese mixtures and condenser tubes; must be free of aluminum brass containing over 0.20 per cent aluminum.
10. Yellow brass castings:
    Shall consist of brass castings in crucible shape, that is, no piece to measure more than 12 inches over any one part; must be free of manganese mixtures and must not contain over 0.20 per cent aluminum.
11. Light brass:
    Shall consist of light sheet brass forks and spoons, miscellaneous brass that is too light for heavy; to be free of any visible iron, radiators, gun shells containing paper, ashes, or iron, loaded lamp-bases, and clockworks.
12. New brass clippings:
    Shall consist of the cuttings of new sheet brass; to be absolutely clean and free from any foreign substances.
13. Brass tubing:
    Shall consist of brass tubing, free of nickel plating, tinned, soldered, or tubes with cast-brass connections; to be sound, clean tubes, free of sediment and condenser tubes.
14. No. 1 red composition turnings:
    To be free of plastic, railroad car box turnings, aluminum, manganese, and yellow brass turnings; not to contain over 2 per cent free iron; to be free of grindings and foreign material, especially Babbitt. Turnings not according to this specification to be sold subject to sample.
15. No. 1 yellow rod brass turnings:
    Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3 per cent free iron, oil, or other moisture; to be free of grindings and Babbitts; to contain not more than 0.30 per cent tin and not more than 0.15 per cent combined iron.
16. No. 1 yellow brass turnings:
    Shall consist of strictly rod turnings, free of aluminum, manganese, composition, and Tobin turnings; not to contain over 3 per cent of free iron, oil, or other moisture; to be free of grindings and Babbitts. To avoid dispute, to be sold subject to sample.
17. No. 1 pewter:
    Shall consist of tableware and soda-fountain boxes, but in any case must test 84 per cent tin. Siphon tops to be treated for separately.
18. Auto radiators (copper and brass):
    Ford, 2 pounds deduction on a Ford plate; three-quarters pound for each iron water connection; 1 pound for each side sheet-iron strip. All other radiators to be subject to deduction for actual iron.
19. Zinc:
    Must consist of clean sheet and cast zinc; also cast batteries, to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.
20. Tin foil:
    Shall consist of pure foil free of lead composition and other foreign ingredients and matters.
21. Electrotype shells:
    Must be hand picked and free of loose dross and chunks of dross.
22. Battery lead plates:
    Shall consist of dry-battery lead plates; moisture not to exceed 1 per cent; allowance to be made for wood, rubber, paper, and excess moisture.
23. New sheet aluminum clippings:
    Shall consist of new sheet aluminum and cuttings; must be free from oil, grease, and any other foreign substances; must be guaranteed not less than 98 per cent pure aluminum.
24. Aluminum wire:
    Shall consist of aluminum wire guaranteed 98 to 99 per cent pure aluminum, and must be free from corrosion and any other foreign substance.

25. Painted sheet aluminum:
Shall consist of painted sheet aluminum, and must be absolutely free from iron, dirt, or any other foreign substance.
26. Aluminum castings:
Shall consist of aluminum castings, free from iron, Babbitt, brass, and any other foreign substance; must not exceed 2 per cent of oil and grease.
27. Old sheet aluminum:
Shall consist of old and manufactured sheet aluminum; must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.
28. Aluminum borings:
To avoid dispute, should be sold subject to sample.
29. Aluminum foil:
Shall consist of pure aluminum foil, free from paper and any foreign ingredients.
30. Babbitt metal:
Shall contain bearing metal of all kinds; shall not contain scrap hard metal, Allen metal (which is copper and lead alloy), die cast, zinc boxes, or type metal.
31. Monel metal scrap:
Must be in sheets, clippings, castings, bars, or rods; must be free of iron and other foreign materials. To avoid disputes, to be sold subject to sample.
32. Monel metal turnings:
Must be free of iron and undue percentage of oil and moisture. To avoid disputes, to be sold subject to sample.
33. Packages:
Shall be good, strong packages, suitable for shipment, and each package to be plainly marked with the gross and tare weights, so that when packages reach their destination their weights can be easily checked.
When goods are not packed according to the above specifications, and shipper wants his rejections returned, the cost of labor shall be charged to the shipper.

REVIEW OF THE SECONDARY-METAL INDUSTRY IN 1924

MARKET CONDITIONS

The most significant feature of the secondary-metal trade in 1924 was the large expansion in the export of certain classes of scrap metals and drosses. This expansion seemed to reflect a change in the raw material situation in Europe, for exports of scrap metals increased in a much greater ratio than those of primary metals. During the same period that exports of scrap metals from the United States showed such large gains the imports of scrap metals from Europe decreased to quantities less than in pre-war years. The decreased imports were not so significant, for the decline merely emphasized the fact that the large postwar stocks of scrap metals in Europe had been consumed or exported.

The recoveries of secondary lead, tin, antimony, aluminum, and nickel increased in 1924, both in quantity and in value. The average price of all the above metals except nickel was greater in 1924 than in 1923. The average price of copper, however, was 1.6 cents less in 1924 than in 1923, and the large decrease in remelted brass scrap and a considerable decrease in the quantity of zinc recovered by redistillation and remelting more than offset the increased quantity and value of the other metals. The decrease in total value from the year 1923 was $4,840,000, or 2 per cent, and the decrease in quantity of metals and alloys recovered was also about 2 per cent. The decreases, however, were not in scrap metals available and collected, but in such material smelted and refined, for much larger quantities

of waste metals and drosses of certain classes were exported and much smaller quantities imported in 1924 than in 1923.

Stocks of scrap metal at dealers' warehouses and at secondary metal refineries were normal in 1924, for the first time since the war. Business was good on the whole, and much more profitable than in 1923. As tin and lead were high in price and lead was sometimes scarce, there was an active demand for white-metal alloys and drosses. Battery plates and mud were especially active at times, and the offerings were below requirements. The supplies of secondary copper and brass were ample in most sections throughout 1924, though the export demand for yellow brass scrap, new brass clippings, and turnings was exceptionally active late in the year and there was a temporary shortage at the eastern seaboard.

In some parts of the West local trade in scrap metals was only fair and there were considerable stocks of old metals. Battery plates and lead scrap were in active demand for water shipment to eastern seaports. The continuation of record-breaking building operations, the large repair programs of the railways, and the good purchases of scrap metals and of alloys made from scrap by the foundries in most sections of the United States created much business for waste-metal products, though competition in the purchase of both scrap and drosses was keen and much of the recovered or remelted material was sold on a close margin of profit. The comparatively wide spread of the price of tin, lead, and antimony during the year gave opportunities for speculation, but most dealers bought cautiously. On the whole business during the year was satisfactory, and much more profitable than for several years.

Large companies, adequately equipped, many of them having widely distributed plants or selling agencies, handle the bulk of the nonferrous scrap and drosses. Buying large quantities of metals and drosses, and employing metallurgists and chemists, they can use scrap to the best advantage and sell metals and alloys on close specifications or by brands. The tendency in the secondary-metal industry will be more and more to consolidation, as it has been in other important industries. The change will bring a steadier supply of guaranteed metals and alloys and induce more foundries and other plants to buy alloys and composition metal instead of virgin pig metals and scrap metals.

The saving and proper segregation of metal wastes by the larger foundries and metal users becomes more general each year, but the higher costs of collecting, shipping, and sorting small quantities of waste metals from country districts and small towns have tended to hamper the movement of such material to the consumer. Fewer itinerant waste collectors frequent the highways and byways, and only a real scarcity and high prices will restore the glory of the old days to the collection of old rags, paper, and small metallic articles discarded by householders, who in their present financial condition scorn to be bothered with keeping such materials and selling them to the wandering junkman for a few cents. It is difficult, moreover, for the seller of such material to realize that the purchaser of junk can not afford to pay more than a tithe of the ultimate cost to the consumer of such waste.

Though the general public has yet a very vague idea of the value of waste metals, manufacturers and large dealers have to know values to continue in business, so they are usually well informed about the market for and the prices of the waste they make. Demand for railway equipment is again normal, and building operations in 1925 are tending more to smaller buildings and plants. However, manufacturing and business conditions generally are good and the automobile industry is better than in 1924, so it is reasonable to expect that the recovery of secondary metals in 1925 will be as large as in 1924, or even larger, and will be as profitable.

PRICES OF SOME SCRAP METALS AND ALLOYS

The dealers' weekly average buying price in New York of heavy scrap copper decreased from 10.60 cents a pound early in January, 1924, to 10.25 cents in the middle of February; it advanced to 11.25 cents in March, then receded to 10.25 in May and to 10 cents in June, which was the low point of the year. In August the price advanced as high as 11.25 cents and was fairly stable until the end of September, when it declined to 10.50 cents. During October and November the price advanced more than 1 cent a pound. In the first week of December scrap copper was quoted at 12 cents a pound, and during the last week of December it was 12.35 cents a pound, the high point of 1924.

No. 1 composition scrap (red brass) showed a range of 2.15 cents a pound in 1924. It began at 8.75 cents in January, was highest at 9.75 in December, and lowest at 7.60 cents at the end of June. The price of heavy lead scrap began the year at 6.75 cents a pound and reached 8.50 cents, the high point of the year, in December. In May and early June 5.75 cents a pound was paid, the lowest price during 1924. The upward trend that began in July and continued until September was followed by a reaction in October. In November the price advanced to 7.85 cents, and in December to 8.50 cents. The range of prices during the year was 2.75 cents, which was larger than usual.

The range in the price of old scrap zinc was 1.25 cents. The price was 4.10 cents a pound in January, and as low as 3.35 cents in June, July, and August. A sharp advance to 4.60 cents occurred in March, but a downward trend began in April and continued until August. The price rose in September but slumped again in October. November established a price of 4.25 cents, then a slight reaction occurred until the last week in December, when the highest point of the year, 4.60 cents, was again reached.

The price of secondary tin usually followed the trend of prices for primary tin, which had a wide range in 1924. Block-tin pipe was quoted as high as 51 cents a pound in March and as low as 35 cents in June and July.

The prices of scrap aluminum and No. 12 alloys were variable, and the quotations for scrap aluminum castings ranged from 17.50 cents a pound in February to 14.84 cents during the period May to August. New aluminum clippings ranged in price from 21.63 cents a pound to 18.62 cents. The highest average monthly price was in May and the lowest in July.

Antimonial lead scrap, especially old battery plates, was in active demand at strong quotations, owing to the high price of lead and the unusual advance in the price of primary antimony because of civil war in China.

Scrap nickel and alloys containing nickel were in much greater demand than in 1923, and the prices closely followed those for primary nickel, which advanced from 26 cents in January to as high as 31 cents in October, November, and December.

Average scrap-metal prices, 1924, in cents per pound [a]

[New York dealers' weekly average buying prices]

Date	Heavy copper	No. 1 composition	Heavy lead	Old scrap zinc	Block-tin pipe	Date	Heavy copper	No. 1 composition	Heavy lead	Old scrap zinc	Block-tin pipe
Jan. 5	10.60	8.75	6.75	4.10	42.00	July 5	10.25	7.75	6.10	3.35	35.00
12	10.35	8.60	6.95	4.20	42.00	12	10.10	7.75	6.10	3.35	35.00
19	10.10	8.25	6.95	4.20	43.00	19	10.25	8.00	6.10	3.35	35.00
26	10.35	8.25	7.20	4.20	43.00	26	10.75	8.00	6.50	3.35	38.00
Feb. 2	10.35	8.25	7.20	4.20	43.00	Aug. 2	10.85	8.25	6.50	3.35	37.50
9	10.25	8.25	7.35	4.20	44.50	9	11.10	8.25	6.50	3.35	43.00
16	10.50	8.50	7.60	4.25	45.50	16	11.20	8.25	6.75	3.35	44.00
23	10.75	8.60	7.25	4.20	48.00	23	11.25	8.60	7.10	3.75	44.00
Mar. 1	10.70	8.75	8.00	4.20	48.00	30	11.20	8.60	7.10	3.75	44.00
8	11.10	9.25	8.10	4.35	51.00	Sept. 6	11.25	8.75	7.00	3.85	46.00
15	11.25	9.25	8.00	4.60	51.00	13	11.20	8.50	7.00	3.85	46.00
22	10.85	8.75	7.60	4.10	46.00	20	11.00	8.35	7.00	3.85	41.00
29	10.75	8.75	7.60	4.10	43.00	27	10.50	8.35	7.00	3.60	41.00
Apr. 5	11.00	8.25	7.30	4.10	43.00	Oct. 4	10.50	8.00	6.85	3.60	41.00
12	10.75	8.75	7.10	4.10	43.00	11	10.50	7.75	6.75	3.60	41.00
19	10.75	8.25	6.60	3.75	43.00	18	10.75	7.75	6.85	3.60	41.00
26	10.75	8.25	6.75	3.85	43.00	25	10.75	7.75	7.20	3.60	44.50
May 3	10.65	8.25	6.35	3.85	41.00	Nov. 1	11.00	8.25	7.30	3.85	44.50
10	10.65	8.25	6.10	3.85	41.00	8	11.25	8.35	7.75	3.85	45.50
17	10.25	8.10	6.10	3.60	39.00	15	11.50	9.10	7.85	4.00	46.50
24	10.25	7.85	5.85	3.75	36.00	22	11.75	9.10	7.85	4.25	49.50
31	10.25	7.85	5.75	3.60	36.00	29	11.75	9.10	7.85	4.10	49.50
June 7	10.25	7.85	5.75	3.60	36.00	Dec. 6	12.00	9.50	7.85	4.10	49.00
14	10.25	7.85	6.00	3.50	36.00	13	11.85	9.50	8.10	4.10	49.00
21	10.25	7.85	6.10	3.50	36.00	20	12.25	9.75	8.50	4.35	49.00
28	10.00	7.60	6.10	3.35	35.00	27	12.35	9.75	8.50	4.60	49.00

[a] Waste Trade Journal, New York, Jan. 17, 1925.

The following monthly average scrap-metal prices at New York in 1924 for new zinc clippings, new aluminum clippings, and cast aluminum, in cents per pound, were quoted by the American Metal Market:

Average scrap-metal prices at New York in 1924, in cents per pound [a]

Month	New zinc clippings	New aluminum clippings	Cast aluminum scrap	Month	New zinc clippings	New aluminum clippings	Cast aluminum scrap
January	4.62	19.38	15.67	August	4.64	19.06	15.07
February	4.70	19.75	16.24	September	4.68	20.60	15.63
March	4.86	21.00	16.75	October	4.62	20.96	15.30
April	4.86	21.09	16.48	November	4.65	21.37	16.00
May	4.61	21.63	15.38	December	4.82	21.37	16.00
June	4.45	19.26	14.84				
July	4.37	18.62	14.85	Year	4.65	20.34	15.72

[a] American Metal Market.

SECONDARY METALS RECOVERED

The quantity of the metals contained in numerous alloys made partly or wholly from secondary material can not be ascertained definitely. The figures given as the result of the annual canvass are only approximate, but they constitute the sole available data on an important industry.

The decrease in the value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferroalloys, recovered in the United States in 1924 was due in part to the lower average price of copper and to the decreased recovery of secondary zinc, but almost entirely to the smaller quantity of scrap brass remelted in the United States.

The value of the secondary platinum metals recovered in 1924 amounted to about $6.570,000, which was 60 per cent of the value of the platinum and allied metals imported for consumption in the United States during the year.

The value of the gold and silver contained in old jewelry, dental waste, tableware, ornaments, and other articles remelted or refined in 1924 was $33,958,030. Mints and refineries reported the recovery of 8,930,580 fine ounces of silver and $27,974,541 in gold from waste or discarded material. Jewelry and dental waste furnish the largest supplies of secondary gold, and silverware and photographic waste of secondary silver.[2] The recoveries of silver from waste film and from photographic solutions probably amounted to more than 1,000,000 ounces.

Most of the silver recovered from photographic waste is obtained from solutions and is recovered by the larger makers of films and plates and by the moving-picture industry. Generally these solutions contain less than half an ounce of silver to the gallon. The recovery from waste film is probably 800 ounces to the million feet [3]

It is difficult to appraise the value of the ferrous scrap remelted in 1924. Estimates of the quantity range from 9,000,000 to 13,000,000 long tons. Estimates can be obtained for scrap iron and steel used at smelting plants, but no data are available for the large quantities of scrap iron used at the thousands of foundries, some of which use as high as 30 to 40 per cent of scrap metal.

A considerable part of the scrap ferrous metal contained nickel, tungsten, manganese, chromium, vanadium, molybdenum, or other alloy metals, which made it much more valuable than the ordinary commercial iron and steel scrap, though the market is limited and some knowledge regarding consumers is necessary in finding prospective purchasers. The railways are, on the whole, the largest producers of most kinds of metal scrap, as well as the largest users of new and remelted metal. It is estimated that the railways usually supply more than 30 per cent of the scrap iron and steel, and industrial plants nearly as much. The National Bank of Commerce, of New

[2] A recent patent for the recovery of silver from solutions used in photographic work is No. 1527942, Feb. 24, 1925, issued to Louis Weisburg, New York, N Y.

[3] Byers, C. A., Recovery of silver from movies' laboratory waste: Eng. and Min. Jour.-Press, Aug. 26, 1922, p. 373.

York, in a review of the scrap iron and steel industry, says that there are about 3,000 scrap iron and steel yards in the United States, and that about 5,000,000 tons of ferrous scrap is derived from country and urban collections, mainly from discarded agricultural and household implements and mining, oil, and gas machinery and equipment. This quantity does not include rails, pipe, machinery, and other equipment renovated and sold for the original use, but only such waste as goes to remelters.

An article by E. J. Lowry, metallurgist, Hickman, Williams & Co., Chicago, Ill., published in the Daily Metal Reporter, October 25, 1924, entitled "How use of scrap promotes conservation of resources," demonstrates the importance of the utilization of waste material in the production of steel, points out the abuses existing in the industry, and suggests remedies for their elimination. Lowry says that the total quantity of iron and steel scrap produced in the United States, taking 10-year averages, is about 24,800,000 tons, and that of this quantity 11,940,000 tons is handled by dealers and brokers and finds its way to market. The remainder stays within the confines of steel mills and furnaces.

It is impracticable and unnecessary to segregate the statistics relating to the melting, refining, and use of secondary metals according to States. Nearly all the secondary aluminum was reported from Ohio, Michigan, Connecticut, Illinois, Pennsylvania, New York, and Missouri. The largest recoveries from tin dross, tin scruff, and clean tin scrap were made in Pennsylvania, New York, New Jersey, California, Indiana, and West Virginia. Nearly all the secondary nickel was reported from Connecticut, New Jersey, and New York. The recoveries of lead, zinc, and copper, and of such alloys as Babbitt, bronze, brass, and pewter, were more generally distributed, though the largest secondary smelters and refineries are in Pennsylvania, Illinois, Missouri, Michigan, Ohio, New York, and New Jersey.

Secondary metals of certain classes recovered in the United States, 1923–24

	1923		1924	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	193,200	$56,800,800	196,500	$51,483,000
Brass scrap remelted	311,000	72,843,800	274,000	58,444,200
Lead as metal	96,430	27,228,600	90,400	32,720,000
Lead in alloys	98,060		114,100	
Zinc as metal	65,210	10,042,200	58,886	9,020,000
Zinc in alloys other than brass	8,630		10,500	
Tin as metal	7,892	25,316,000	7,700	31,062,100
Tin in alloys	22,318		23,600	
Antimony as metal	245	1,252,800	90	2,025,600
Antimony in alloys	7,776		9,314	
Aluminum as metal	6,800	10,824,600	10,350	14,596,200
Aluminum in alloys	14,500		16,650	
Nickel as metal	177	1,109,800	114	1,227,500
Nickel in nonferrous alloys and salts	1,373		2,126	
	.....	205,418,600	.....	200,578,600

SECONDARY COPPER

Secondary copper recovered in the United States, 1923–24, and imports and exports of brass and copper scrap, in short tons

	1923	1924
Copper as metal	141,300	141,500
Copper in alloys other than brass	51,900	55,000
	193,200	196,500
Copper from new scrap (not including brass)	35,000	36,000
Copper from old scrap (not including brass)	158,200	160,500
	193,200	196,500
Brass scrap remelted:		
New clean scrap	150,000	123,000
Old scrap	161,000	151,000
	311,000	274,000
Copper content of brass scrap (averaging 70 per cent copper):		
New scrap	105,000	86,100
Old scrap	112,700	105,700
	217,700	191,800
Total secondary copper (including copper content of brass scrap):		
From new scrap	140,000	122,100
From old scrap	270,900	266,200
	410,900	388,300
Brass scrap imported	20,395	4,636
Scrap copper imported	2,743	1,855
Brass scrap exported	6,587	29,294
Scrap copper exported	1,772	2,597

Of the total quantity of secondary copper recovered in 1924, 77,409 tons (11,690 tons more than in 1923) were recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of secondary material included 64,091 tons of pig copper, 55,000 tons of copper in alloys other than brass, and 191,800 tons of copper in remelted brass. These figures indicate decreases of 11,490 tons in pig copper and 25,900 tons in brass, and an increase of 3,100 tons in alloys other than brass.

The value of the copper, both as metal and in alloys, computed at 13.1 cents a pound, the average price for the year of all marketable grades of new metal, amounted to $101,734,600.

According to the Bureau of Foreign and Domestic Commerce the exports of scrap copper and brass in 1924 increased 23,532 tons and the imports decreased 16,647 tons. Railways sell or turn in the larger part of their brass and copper scrap and other metal waste to dealers in part payment for new material, but the reports show that the railways utilized in their own shops and foundries more than 7,400 tons of brass in addition to 1,500 tons of copper and 13,900 tons of copper in alloys other than brass. The railway reports, however, frequently include under "brass" alloys that should more properly be designated "bronze." On the other hand, manganese bronze should be called manganese brass,[4] and scrap metals can be successfully employed in making it. It is probable that the increase of 3,100 tons of copper in alloys other than brass was due largely to a better separation of copper alloys.

[4] Livermore, F. A., Manganese bronze—the use of scrap: Brass World, February, 1923, pp. 43–44.

The names recommended by the American Society for Testing Materials to be used in connection with certain brass, bronze, and nickel alloys of copper are given in the report on secondary metals in Mineral Resources for 1919.

The bulk of the domestic brass scrap accumulated during the World War has passed into consumers' hands, so that the war scrap has ceased to have any effect on the domestic scrap-metal market. The shipments of brass scrap to the United States, which in 1922 were 71,962 tons (much greater than in normal years), decreased to 20,395 tons in 1923 and to 4,636 tons in 1924. On the other hand, scrap copper and scrap brass exports increased sharply, and representatives of foreign smelters actively competed with domestic smelters for large lots of all kinds of scrap metals and alloys, especially scrap brass and tin-bearing alloys. The exports of brass scrap in 1924 were 22,707 tons more than those of 1923. The exhaustion of supplies of European brass scrap is shown by the small imports to the United States. These imports have decreased 67,326 tons since 1922. The increased exports and decreased imports account for the decline in the quantity of brass scrap remelted—from 311,000 tons in 1923 to 274,000 tons in 1924, as about 40,000 tons less of brass scrap was available for remelting and refining in the United States.

S. Skowvonski, metallurgist of the Raritan Copper Co., has said that there is undoubtedly room for considerable increase in the use of scrap in the production of copper alloys. Clean scrap metal is an advantage rather than a detriment in remelting, and it is perfectly good practice to use as much as 90 per cent scrap in the total melting. He has also estimated that nearly 75 per cent of fabricated copper in everyday use eventually returns to be consumed in the form of scrap.

Every year fewer foundries purchase copper scrap and brass scrap, and each year they consume larger quantities of composition metal made from scrap by the secondary smelters and refiners. However, considerable quantities of scrap metals can be satisfactorily melted directly in large foundries by carefully analyzing the melting.[5]

SECONDARY LEAD

Secondary lead recovered in the United States, 1923–24, in short tons

	1923	1924
Secondary lead recovered by smelters that treat mainly ore	36,604	31,398
Secondary lead recovered by smelters that treat only scrap and drosses	59,826	59,002
	96,430	90,400
Secondary lead recovered in remelted alloys:		
Lead content of antimonial lead scrap treated at regular lead smelters	2,594	6,630
Lead content of drosses and scrap alloys treated at secondary smelters	95,466	107,470
	98,060	114,100
Total secondary lead recovered	194,490	204,500

Refined primary lead produced in the United States, 1923–24, in short tons

	1923	1924
From domestic ore	543,841	566,407
From foreign ore and base bullion	74,481	124,086
Lead content of antimonial lead from foreign and domestic ores and bullion treated at regular smelters	12,020	18,024

[5] Deterding, Henry C., Melting scrap direct in the foundry: Metal Industry, July 1924, p. 273.

The secondary lead recovered in 1924 amounted to 5 per cent more than in 1923; that recovered as pig lead decreased 6,030 tons and that recovered by those smelters whose product is mainly primary metal decreased 5,206 tons, but that recovered in alloys increased 16,040 tons. A considerable part of the lead recovered from alloys was derived from old Babbitt metal, solder, type metal, and white-metal drosses, but the main sources of secondary pig lead are old pipe, lead cable, battery plates, and lead lining of acid tanks. Regular primary smelters reported the recovery of 6,630 tons of lead in scrap antimonial lead, or 4,036 tons more than in 1923. About 644 short tons of lead was contained in materials imported under the classification of type metal in 1924, 3,033 tons less than in 1923.

The use of lead in batteries has expanded rapidly with the growth of the automotive and radio industries, and a very large part of the secondary lead now recovered is obtained from old batteries.

The total output of secondary lead was equal to 30 per cent of the refined primary lead produced in the United States in 1924, compared with 31 per cent in 1923, and was not exceeded by the output of primary domestic lead in any one State.

SECONDARY ZINC

Secondary zinc recovered in the United States, 1923–24, and products made from zinc dross, skimmings, and ashes, in short tons

	1923	1924
Secondary zinc recovered by redistillation	39,434	35,486
Secondary zinc recovered by sweating, remelting, etc	25,776	23,400
Total zinc recovered unalloyed	65,210	58,886
Zinc recovered in alloys other than brass	8,630	10,500
Zinc recovered in brass (estimated)	65,000	63,000
Zinc dust made from zinc dross	4,402	5,659
Zinc dross used for zinc dust (estimated)	5,136	6,600
Zinc dross, concentrates, and ore exported	14,745	10,845
Lithopone made from zinc skimmings and ashes	43,902	37,564
Secondary zinc content of lithopone	8,723	7,492
Zinc chloride made from zinc skimmings, ashes, etc	43,089	42,574
Zinc content of zinc chloride made from zinc skimmings, etc	9,478	9,367
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc	1,241	858

Secondary zinc recovered as pig metal and in alloys showed a decrease in the total quantity recovered in 1924. Less zinc dross was exported than in 1923, and more zinc dust was made from dross, skimmings, etc. The estimated zinc content of brass remelted in 1924 decreased 2,000 tons from that in 1923.

In addition to the 58,886 tons of remelted and redistilled zinc, 37,564 tons out of a total production of 117,222 tons of lithopone (a zinc pigment containing approximately 20 per cent zinc) was made from zinc skimmings and ashes. It is estimated that the zinc content of skimmings and ashes used for lithopone was 7,492 tons, a decrease of 1,231 tons. The quantity of zinc chloride made in 1924 was 48,321 tons, of which 42,574 tons, containing 9,367 tons of zinc, was made from zinc ashes, skimmings, etc.

The secondary zinc recovered in all zinc pigments in 1924, including that in lithopone, was 9,021 tons, and that recovered in zinc sulphate 858 tons. The exports of zinc drosses, which amounted to

5,123 tons in 1919, 2,445 tons in 1920, 510 tons in 1921, and 8,412 tons in 1922, were not separately recorded by the Bureau of Foreign and Domestic Commerce for 1923 and 1924. It is estimated that the zinc recovered in brass decreased from 65,000 tons in 1923 to 63,000 tons in 1924.

Two plants in San Francisco are making zinc dust from zinc dross, so that all that material available on the Pacific coast has a good market; but none of the secondary plants on the Pacific coast treat zinc ashes or skimmings, which must be shipped to eastern plants for treatment. About 6,600 tons of dross was used in the United States in 1924 to make 5,659 tons of zinc dust.

The recovery of secondary zinc (including that in brass) in 1924 was 25.6 per cent of the output of primary zinc in the United States. This recovery was about 6,400 tons less than in 1923. The American Iron and Steel Institute reports that the quantity of galvanized sheets and forms made in 1924 was 1,192,431 short tons, or about 73,000 tons less than in 1923. Only a small part of the zinc used in galvanizing is recovered, though some zinc chloride is made from clippings from galvanized sheets. The zinc content of zinc chloride or zinc sulphate made from galvanized clippings was probably less than 1,000 tons.

Four smelters—one each in New Jersey, New York, West Virginia, and Pennsylvania—treated zinc drosses and skimmings by means of large graphite retorts of 600 to 800 pounds capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. Zinc drosses and skimmings have many uses, and these create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are then sold for redistillation.

The production of zinc from drosses and skimmings made by smelters by redistillation was 3,948 tons less in 1924 than in 1923.

The zinc recovered in alloys other than brass amounted to 10,500 tons, compared with 8,630 tons in 1923. Of the secondary zinc recovered unalloyed 60 per cent was obtained by redistillation from drosses and skimmings, and the remainder by sweating, remelting, etc.

SECONDARY TIN

Secondary tin recovered in the United States, 1923–24

	1923	1924
Tin recovered as pig tin ---------- short tons	7,892	7,700
Tin recovered in alloys and chemical compounds ---------- do	22,318	23,600
	30,210	31,300
Clean tin-plate scrap treated ---------- long tons	162,732	166,303
Old tin-coated containers treated ---------- do	262	----------
Metallic tin recovered at detinning plants ---------- pounds	1,871,600	2,035,600
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants ---------- pounds	3,962,500	4,032,800
Total tin recovered at detinning plants ---------- do	5,834,100	6,068,400
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants ---------- pounds	7,939,917	8,106,107
Average quantity of tin recovered per long ton of old tin-coated containers ---------- pounds	22.4	----------
Average quantity of tin recovered per long ton of clean tin-plate scrap ---------- do	35.85	36.49

Tin and tin concentrates imported and tin produced from imported concentrates in the United States, 1923–24, in short tons

	1923	1924
Tin imported as metal	77,166	72,866
Tin concentrates imported	3,015	[a] 174
Tin produced from foreign concentrates smelted in the United States	7,466	486

[a] Recorded as tin content.

The United States consumes more than 50 per cent of the world's output of tin, but apparently no metallic tin was derived from domestic mines in 1924, though 11 short tons of tin concentrates were recovered from placer mines in the Hot Springs and Port Clarence districts, Alaska.

The secondary tin recovered increased from 30,210 tons, valued at $25,316,000, in 1923, to 31,300 tons, valued at $31,062,100, in 1924, equal to 43 per cent of the tin imported as pig metal and smelted from foreign concentrates in the United States during the year (73,352 tons). The value here assigned to the recovered tin is arbitrary, and is based on the yearly average price (49.62 cents per pound) for 99 per cent metal, with prompt delivery at New York, given by the American Metal Market. The secondary tin in alloys increased 1,282 tons, and the secondary pig tin decreased 192 tons.

Nearly all clean tin-plate scrap is detinned by the electrolytic alkali process, the chlorine process, or the alkali saltpeter process.[6]

The tin reported recovered in alloys and compounds in 1924 included the tin content of products made in several plants from clean tin-plate scrap. The materials recovered included some tin crystals, tin oxide, and putty powder, but consisted mainly of tin tetrachloride and tin bichloride. The production of these compounds is stated together, in order to avoid disclosing confidential information. As the products are made from scrap tin and thus conserve the primary metal, they are properly regarded as recovered tin.

The largest recoveries of tin were made from the scruff and drosses that occur in making tin plate and terneplate; they amounted to about 6,100 tons. The quantity of tin plate and terneplate made in 1924 (according to the American Iron and Steel Institute) was 1,418,654 long tons, or about 88,000 tons less than in 1923.

About 3,034 short tons of tin was recovered from clean scrap tin plate, either as pig tin or as tin chloride, tin crystals, or tin oxide. Apparently only about 600 tons of pig tin was recovered from scrap tin (not tin plate), clippings, old tin pipe, tin foil, and collapsible tubes, and it is impossible to give separately the quantities of tin recovered from these sources. Old block-tin pipe is most acceptable scrap, but the quantity available is small and is steadily declining. A considerable quantity of tin was also recovered from waste tin liquors used in dyeing.

Nearly all the tin-plate scrap imported in 1924 came from Canada. A comparatively small quantity of old tin containers was used to make sash weights by remelting in a cupola. No tin was recovered from this process, and the impure metal recovered is not suitable for ordinary castings, being too brittle. An investigation conducted by

[6] A short history of the detinning industry: Chem. and Met. Eng., August, 1917, pp. 187–189.

the Bureau of Mines showed that in an electric furnace detinning the scrap was impracticable, though synthetic cast iron made from tin-plate scrap was used successfully in making castings of good quality. A small part of the clean tin strips cut from sheets is sold to makers of boxes and baskets, who use it to bind, strengthen, or fasten the tops of the containers they make.

Formerly a large copper mine used tin-plate scrap from canning factories to recover copper from mine waters, but it now uses baled detinned scrap. This scrap costs about $19 a ton, and 1 pound of it is necessary to precipitate 1 pound of copper.

A large quantity of tin was recovered in bronze, and part of the brass remelted contains a little tin and lead, which in the aggregate amounts to a considerable quantity. Other alloys from which secondary tin was recovered were solder, Babbitt, pewter, terne metal, and electrotype metal.

Reports received show that the clean tin-plate scrap detinned in 1924 was 3,571 long tons more than in 1923. The average metallic content of the tin oxide was given as 78 per cent, that of the tin bichloride as 24.5 per cent, tin crystals 52.6 per cent, and tin tetrachloride 45.4 per cent.

The relatively small quantity of secondary tin recovered from tin-plate scrap and old tin-coated cans is significantly shown when compared with the quantity of tin used in making tin plate. It is estimated that 28,900 short tons of tin were used by makers of tin plate in 1924, and that the total recovery of tin as metal and in compounds from tin-plate scrap was 3,034 short tons.

A description of the method used in treating old tin-coated cans is given in Mineral Resources for 1919.

New tin-plate clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill., by the Johnson & Jennings Co., of Cleveland, Ohio, and at the plants of the Metal & Thermit Co. at San Francisco, East Chicago, Ind., and Chrome, N. J.

The plants utilizing old tin cans, which can handle 25,000 tons a year, treated none in 1924. These plants have never received shipments large enough to operate steadily at full capacity, even when the prices of tin and black sheet-metal scrap were high. The present prices do not warrant even local collections of old cans, and the plants are idle.

Although there is now a supply of tin sufficient for all requirements, there are two good reasons for restricting its use to the lowest point. One is that the supply of new tin is derived almost entirely from foreign sources, and the other is that tin is a relatively high-priced metal, and the use of substitutes giving approximately equal efficiency radically reduces the cost of many alloys, such as solder, Babbitt, and other bearing metals.

SECONDARY ANTIMONY

The production of secondary antimony in the United States in 1924, of which all but 90 tons was recovered in alloys, amounted to 9,404 tons, an increase of 17 per cent over 1923. The value given in the table on page 129 is based on the average yearly price for ordinary brands of antimony as published by the American Metal Market.

The regular smelters reported the recovery of 944 tons of antimony, contained in 7,574 tons of antimonial-lead scrap. The recovery from secondary sources was nearly equal to the imports. The principal materials refined or resmelted that contained antimony as an alloy were hard-lead drosses, Babbitt, battery plates, solder, pewter, and type metal. Antimony used in the rubber, glass, enamel, paint, and ceramic industries does not yield any secondary recoveries. The quantity of antimony used for coloring rubber and for pigments has materially increased, owing to the higher price of quicksilver.

No production of antimony from domestic antimony ore was reported in 1924. There was 20,787 short tons of primary antimonial lead, which contained 2,763 tons of antimony, recovered at the smelters. Of the 20,787 tons of antimonial lead, 13,593 tons were produced from domestic ores. The antimony imported in ore, as metal, or as oxide or salts amounted to 9,442 short tons.

The National Lead Co. early in 1925 purchased from the Metallurgical & Chemical Corporation the plant and the Harris process for refining lead. The application of the process is said to remove antimony and other alloys and impurities and to result in the recovery, in a form easily reducible to metal, of 99 per cent of the antimony contained in alloys. Old battery plates and mud are now bought at a price based on the price of pig lead at St. Louis on the day of purchase, and the antimonial content is ignored in fixing the price, the antimony content being paid for as lead. Antimony sold as high as 17.5 cents a pound in 1924, and the average price for the year 1924 was 10.77 cents, or 2.77 cents more than that of lead. Antimony has been separated from antimonial lead, but the practice has not been general, and because of the cost and difficulty of separation the old battery plates are usually remelted and marketed as antimonial lead. The antimony content of antimonial lead varies from as low as 3 per cent to as high as 20 per cent. The average is between 4 and 8 per cent, and a process which cheaply separates metal bought at 5 to 6 cents a pound must result in additional profits when refined pig lead and antimony can be marketed at the present comparatively high prices.

SECONDARY ALUMINUM

Secondary aluminum recovered in the United States, 1923–24, in short tons

	1923	1924
Secondary aluminum recovered unalloyed	6,800	10,350
Aluminum recovered in alloys (mainly No. 12)	14,500	16,650
	21,300	27,000

Primary aluminum produced in the United States and imported and exported, 1923–24

	1923	1924
Value of primary aluminum produced in the United States	$28,305,000	$37,607,000
Aluminum (crude and semicrude) imported for consumption, pounds	42,476,789	31,809,941
Aluminum (crude and semicrude) exported, do	5,539,671	6,343,512
Primary aluminum produced in the United States (according to American Bureau of Metal Statistics), short tons	64,500	72,200

The recovery of secondary aluminum as pig aluminum or in alloys in 1924 amounted to 27,000 short tons, valued at $14,596,200, compared with 21,300 tons, valued at $10,824,600, in 1923.

Some of the larger secondary smelters and refiners of aluminum in 1924 were as follows:

Apex Smelting Co., Chicago, Ill.
Aurora Refining Co., Aurora, Ill.
Bohn Aluminum & Brass Corporation, Detroit, Mich.
Cleveland Electro Metals Co., Cleveland, Ohio.
Federated Metals Corporation, New York, N. Y.
Ford Motor Co., Detroit, Mich.
General Metal Refining Co., St. Louis, Mo.
Charles L. Hilb Smelting & Refining Co., Cincinnati, Ohio.
W. F. Jobbins Co. (Inc.), Aurora, Ill.
Loewenthal Co., Chicago, Ill.
Michigan Smelting & Refining Co., Detroit, Mich.
National Smelting Corporation, Cleveland, Ohio.
Niagara Falls Smelting & Refining Co., Buffalo, N. Y.
Peninsular Smelting & Refining Co., Detroit, Mich.
United Smelting & Aluminum Co., New Haven, Conn.
United States Aluminum Co., Pittsburgh, Pa.
United States Reduction Co., East Chicago, Ind.

Various products are made by smelters and refiners from scrap aluminum.

A large quantity of No. 12 secondary ingots (92 per cent aluminum and about 8 per cent copper) is made by smelters from old or defective castings, borings, and scrap, as is shown by the fact that the secondary recovery of aluminum in alloys was 62 per cent of the total recovery in 1924. The expanded output of the automotive industry, which is estimated to consume more than 25 per cent of the aluminum production, is reflected in the increased consumption of secondary No. 12 alloy. The recovery of aluminum in alloys in 1924 was 15 per cent more than that reported in 1923. The recent articles relating to aluminum are as follows:

Anderson, Robert J., Smelting secondary aluminum scrap: Metal Industry, January, 1925, page 10.

Knerr, Horace, Aluminum alloy castings from sheet scrap: Metal Industry, December, 1924, pages 481–482.

Anderson, Robert J., and Boyd, Edward, Salvage and reclamation of aluminum alloy castings by soldering and welding: Reprint No. 412, American Foundrymen's Association, October, 1924.

Meritorious aluminum alloys: Brass World, March, 1925, pages 105–106.

The following articles on aluminum were published in the report for 1919 on secondary metals:

Casting losses in aluminum foundry practice in the United States, by Robert J. Anderson.

Scrap aluminum, by Charles Vickers.

Tentative specifications for aluminum, presented to the American Society for Testing Materials.

SECONDARY NICKEL

Secondary nickel recovered in the United States, 1923–24, in short tons

	1923	1924
Nickel recovered as metal	177	114
Nickel recovered in nonferrous alloys and salts	1,373	2,126
	1,550	2,240

Primary nickel produced in the United States and imported and exported, 1923–24, in short tons

	1923	1924
Nickel produced as a by-product from the electrolytic refining of copper at domestic refineries	100	191
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	20,335	18,459
Nickel oxide and matte exported	6	
Nickel, Monel metal, and other alloys exported	434	938

The nickel recovered from secondary sources in 1924 includes nickel in Monel metal but not in ferrous alloys. Most of the nickel in imported matte, oxide, ore, etc., came from the Sudbury district, Ontario.

The secondary metal recovered from nonferrous sources in 1924 was equal to 12 per cent of the imports.

Since the World War much less nickel is used in ferrous alloys. The International Nickel Co. says that the sales in 1923 and 1924 indicate that approximately 40 per cent of the nickel it sold was used in ferrous alloys, 16 per cent in nickel silver, 26 per cent in anodes, 11 per cent in special alloys, including nichrome, and 7 per cent for miscellaneous purposes.

As nickel is used chiefly as an alloy in steel, and as the secondary nickel reported as recovered in 1924 was obtained solely from nonferrous scrap, it is evident that the 2,240 tons of nickel reported forms only a portion of the nickel in alloys recovered and reused.

An article by J. A. Wadhams, entitled "Nickel, Monel, since the war," quoted in the Brass World, May, 1924, discusses the development in the nickel industry because of the change from use almost wholly for ordnance to use for the arts of peace.

Recent data on the properties and application of nickel and its alloys are given in a revised edition of a circular issued by the Bureau of Standards, Washington, D. C.

A critical survey shows that the use of nickel steel for automobile construction and for general machinery and equipment is steadily expanding. Nickel is also being more generally used instead of brass, bronze, and silver-plated alloys in dairy, laundry, cafeteria, and household equipment. For this reason it is certain that the quantity of secondary nickel recovered will greatly increase in a few years. Good sand-cast Monel metal castings can be made using as much as 40 per cent foundry scrap, but care should be used in purchasing such scrap.[7]

In its printed annual report and its publication Inco the International Nickel Co. calls attention to the intensive research for and development of new uses for nickel, Monel metal, and other nickel alloys. Research and advertising are bringing results that will more than compensate for the losses sustained by the reduction of armaments and ordnance.

The secondary nickel reported in 1924 was nearly all recovered from old nickel anodes, nichrome, nickel silver, and Monel metal. A nickel alloy called "nichrome," which is now being more gener-

[7] Sand casting Monel metal: Metal Industry, February, 1925, pp. 55 and 56.

ally used, contains about 60 per cent nickel; the remainder is mainly chromium. Extracts from an article in the Brass World giving the properties and uses of this alloy, which is used in heat treatment of steel, are printed in the report on secondary metals in 1919.

The use of nickel in brass and white metals is becoming more general. The beneficial use for many purposes of nickel in such alloys is set forth in an article by W. M. Corse, published in the Brass World, November, 1924, pages 397–398.

Analyses of various nickel alloys have been published by the United States Geological Survey.[8]

The International Nickel Co., desiring to assist users of Monel metal to dispose of scrap and at the same time to protect the purity of the primary metal, has established a definite procedure in the purchase of Monel scrap. The company's publication Inco contains the following information:

The mining and smelting operations are located at Copper Cliff, Ontario; the refining and rolling operations are located at Port Colborne, Ontario, and Huntington, W. Va. Monel-metal scrap must enter operations at one of these points. This is decided to a large extent by the purity of the scrap.

Monel metal as produced is held to a close chemical specification. It contains approximately 67 per cent of nickel, 28 per cent of copper, and 5 per cent of other elements. It has in it no lead and no zinc.

If the user has not allowed other materials to become mixed with his scrap it should meet production specification. However, it is not entirely possible to prevent all contamination, and in the purchase of scrap the International Nickel Co. allows a certain tolerance. Therefore, scrap within the analysis given below will be purchased at a flat price, which will be quoted on receipt of detailed description of the scrap offered from time to time by the consumer.

Nickel, not less than 64 per cent; copper, not less than 27 per cent; iron, not more than 3½ per cent; sulphur, not more than 0.05 per cent; lead, none; zinc, none.

Provided such scrap does not come within the above analysis, settlement will be made on a basis of copper-nickel content, the price of which will be quoted after sampling and analysis by the International Nickel Co. All scrap will be purchased and settled for on a basis of weight, sample, and analysis.

The cost of sampling and analyzing a shipment of scrap is approximately $35. It is therefore necessary to avoid handling small shipments of scrap if possible, and all consumers are requested to collect their scrap until they have at least 500 pounds before offering it for sale.

[8] Hess, F. L., Nickel: U. S. Geol. Survey, Mineral Resources, 1915, pt. 1, pp. 763–765, 1917.

LEAD AND ZINC PIGMENTS AND SALTS

By C. E. Siebenthal and A. Stoll

GENERAL CONDITIONS

Lead and zinc pigments and salts are made both by smelting and by chemical processes. Sublimed lead, or basic lead sulphate, and the various lead oxides are lead pigments produced by sublimation in oxidizing furnaces; basic carbonate white lead and the lead salts are made by chemical processes. Sublimed lead, or basic lead sulphate, is made directly from ore, but the lead oxides as well as white lead and lead salts are made from pig lead.

Zinc oxide and leaded zinc oxide are made by the American process directly from ore by sublimation in an oxidizing furnace, but some zinc oxide is made in this country by the French process, in which metallic zinc is sublimated in an oxidizing furnace. Lithopone and zinc salts are made by chemical processes, the zinc base being derived from zinc ore, metallic zinc, galvanizers' ashes, or scrap zinc. Lithopone is made by mixing equivalent portions of solutions of zinc sulphate and barium sulphide, which brings about a mutual precipitation of zinc sulphide and barium sulphate either in chemical combination or as a very intimate mixture.

The sales of nearly all lead and zinc pigments and salts, as reported by producers, showed gains in 1924 as compared with 1923. Sales of sublimed lead, or basic lead sulphate, made the greatest gain—23 per cent. Demand for white lead, or basic carbonate, was also reported good and sales increased 15 per cent. Sales of lithopone showed a continued increase, making a gain of 11 per cent over those of 1923. The sales of zinc oxides also kept pace with increased demands and advanced 5 per cent.

The French process zinc oxide plants of the International Lead Refining Co., at Akron, Ohio, and East Chicago, Ind., put new units in operation in January, 1924, and October, 1924, respectively, thereby doubling their capacity. Some crude zinc oxide was produced during the year at the Bully Hill plant of the California Zinc Co., Winthrop, Calif. The lithopone plant of the Chemical & Pigment Co., St. Helena, Md., doubled its capacity. Increased capacity was reported by the lithopone plants of the Krebs Pigment & Chemical Co., Newport, Del., and the St. Louis Lithopone Co., Collinsville, Ill. The new lithopone plant of the Mineral Point Zinc Co., at Depue, Ill., reported a substantial output. Former producers of zinc oxide that

have either permanently or temporarily discontinued the manufacture of this product are: American Smelting & Refining Co., Omaha, Nebr.; American Steel & Wire Co., Donora, Pa.; American Zinc & Chemical Co., Langeloth, Pa.; Bartlesville Zinc Co., Bartlesville, Okla.; Bertha Mineral Co., Austinville, Va.; Trenton Zinc & Chemical Co., Trenton, N. J.; and Utah Zinc Co., Murray, Utah

PRODUCTION

In this chapter the pigments and salts sold are taken to represent the production, no account being taken of the stocks on hand at the beginning and end of the year. The amounts used by producers at their own plants are included under sales.

Lead pigments and salts sold by domestic manufacturers in the United States, 1923 and 1924

	1923			1924		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Sublimed lead, or basic lead sulphate:						
White	11,949	$1,959,068	$164	14,572	$2,391,038	$164
Blue	800	134,356	168	1,088	178,899	164
Red lead	38,037	7,611,508	200	36,813	7,707,264	209
Orange mineral	646	181,066	280	331	89,825	271
Litharge	75,107	14,059,979	187	74,724	14,597,434	195
White lead:						
Dry	37,786	6,615,114	175	42,622	7,900,519	185
In oil	125,087	27,010,116	216	144,872	35,003,984	242
Lead acetate	616	160,133	260	(a)	(a)	(a)
Lead arsenate	5,378	2,229,431	415	(a)	(a)	(a)

[a] Statistics for lead arsenate and lead acetate collected biennially by the Bureau of the Census, for odd years.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1923 and 1924

	1923			1924		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [a]	126,987	$18,750,972	$148	131,470	$19,784,257	$150
Leaded zinc oxide [a]	23,504	2,815,985	120	26,729	3,350,965	126
Lithopone	98,199	11,608,443	118	109,469	12,531,397	114
Zinc chloride, 50° Baumé	42,431	1,958,187	46	51,054	2,051,782	40
Zinc sulphate	5,375	261,449	49	4,674	228,709	49

[a] Zinc oxide containing 5 per cent or more of lead is classed as leaded zinc oxide.

Lead pigments sold by domestic manufacturers in the United States, 1920–1924, in short tons

Year	White lead		Sublimed lead or basic lead sulphate		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1920	33,678	112,017	12,412	928	[a]34,431	([a])	62,329
1921	26,738	143,545	11,568	463	21,805	381	41,909
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107
1924	42,622	144,872	14,572	1,088	36,813	331	74,724

[a] Figures for red lead include orange mineral prior to 1921.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1920–1924, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° Baumé)	Zinc sulphate
1920	99,444	30,460	89,373	[a]68,945	[a]3,072
1921	74,329	16,103	55,016	59,457	3,295
1922	128,465	19,613	83,360	41,627	5,078
1923	126,987	23,504	98,199	42,431	5,375
1924	131,470	26,729	109,469	51,054	4,674

[a] Figures represent production.

SOURCE

Metal content of lead and zinc pigments and salts sold by domestic manufacturers, 1923–1924, by sources, in short tons

Source	1923				1924			
	Lead		Zinc		Lead		Zinc	
	Pigments [a]	Salts [b]	Pigments	Salts	Pigments [a]	Salts [b]	Pigments	Salts
Domestic ore	13,612	([b])	115,490	1,573	15,338	([b])	108,002	1,075
Foreign ore		([b])	480		545	([b])	280	
Metal	236,541	([b])	25,780	6	250,930	([b])	33,096	450
Secondary materials [c]		([b])	10,322	10,719		([b])	9,021	10,225
	250,153	([b])	152,072	12,298	266,813	([b])	150,399	11,750

[a] Includes also lead recovered in zinc oxide and leaded zinc oxide.

[b] The source of the lead contained in lead salts is unknown to the authors, as statistics of production are collected biennially by the Bureau of the Census and for odd years only. Lead acetate is made from litharge, from granulated lead, and from white-lead residues. Lead arsenate is made from lead acetate or lead nitrate. All having been derived from pig lead, their content has already been taken into statistical account.

[c] Zinc ashes, skimmings, drosses, and old metal.

IMPORTS AND EXPORTS

The following statistics of imports and exports of lead and zinc pigments and salts have been compiled from the publications or records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the Bureau of Mines.

Basic carbonate white lead, red lead, litharge, and orange mineral imported for consumption in the United States, 1920–1924

Year	Basic carbonate white lead		Red lead		Litharge		Orange mineral	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	159, 977	$19, 449	23, 076	$1, 789	21, 002	$2, 647	52, 094	$5, 352
1921	124, 176	12, 598	12, 236	689	100	7	77, 937	7, 830
1922	222, 465	21, 335	1, 405	94	1, 770	162	111, 419	9, 729
1923	336, 892	31, 386	3, 600	220	22, 525	1, 314	116, 293	9, 031
1924	141, 156	13, 478	1, 874	155	1, 838	193	99, 341	8, 047

Zinc oxide, lithopone, zinc sulphide (white), zinc chloride, and zinc sulphate imported for consumption in the United States, 1920–1924

Year	Zinc oxide				Lithopone	
	Dry		In oil		Short tons	Value
	Short tons	Value	Short tons	Value		
1920	1, 431	$289, 890	14	$3, 596	1, 714	$263, 240
1921	1, 286	145, 071	57	17, 549	5, 247	432, 019
1922	2, 712	361, 599	42	8, 595	10, 263	885, 671
1923	1, 036	169, 415	89	21, 934	10, 440	776, 383
1924	1, 703	229, 629	110	25, 874	6, 830	543, 025

Year	Zinc sulphide[a]		Zinc chloride		Zinc sulphate	
	Pounds[a]	Value	Short tons	Value	Short tons	Value
1920	45, 482	$15, 027	565	$76, 495	50	$3, 038
1921	93, 537	8, 330	2, 199	213, 995	17	820
1922	27, 159	8, 453	1, 374	87, 509	17	1, 064
1923	11, 844	5, 403	551	44, 164	20	3, 466
1924	9, 678	5, 727	319	28, 911	13	1, 265

[a] Zinc sulphide is stated in pounds rather than tons because of its high value and smaller quantities.

White lead and red lead exported from the United States, 1920–1924

Year	White lead [a]		Red lead [b]	
	Short tons	Value	Short tons	Value
1920	14, 901	$3, 195, 101	1, 532	$365, 575
1921	5, 161	993, 130	548	115, 500
1922	4, 598	710, 765	1, 683	294, 133
1923	[a] 5, 172	836, 261	[b] 1, 840	372, 828
1924	[a] 5, 055	853, 444	[b] 940	210, 598

[a] White lead and sublimed lead not classified separately after 1922; the figures for 1923 and 1924 may include an unknown quantity of sublimed lead.

[b] Exports of red lead and litharge not classified separately after 1922; the figures for 1923 and 1924 may include an unknown quantity of litharge.

White lead[a] exported from the United States, 1923 and 1924

[Figures in parentheses not duplicated in totals]

Destination	1923		1924	
	Short tons	Value	Short tons	Value
Africa	(b)	$62	(b)	$158
Asia	53	8,602	6	1,418
Australia and Oceania	277	60,391	189	44,089
Australia	(11)	(2,436)	(5)	(1,196)
New Zealand	(b)	(45)		
Philippine Islands	(254)	(54,860)	(179)	(41,536)
Canada	216	36,145	176	30,576
Cuba	126	25,472	69	15,226
Europe	2,680	362,511	2,912	450,820
Belgium	(1,272)	(165,115)	(847)	(123,558)
Great Britain	(909)	(128,626)	(1,614)	(258,720)
Netherlands	(490)	(67,558)	(437)	(65,987)
Mexico	99	24,240	96	23,928
Panama	288	60,380	58	12,838
South America	1,309	229,054	1,443	249,786
Brazil	(12)	(1,961)	(2)	(589)
Colombia	(9)	(2,538)	(9)	(2,268)
Uruguay	(144)	(24,729)	(98)	(15,915)
Venezuela	(9)	(2,121)	(9)	(2,078)
Other countries	124	29,404	106	24,605
	5,172	836,261	5,055	853,444

[a] White lead and sublimed lead not classified separately after 1922; the figures may include an unknown quantity of sublimed lead.
[b] Less than 1 ton.

Zinc oxide and lithopone exported from the United States, 1920–1924

Year	Zinc oxide		Lithopone[a]	
	Short tons	Value	Short tons	Value
1920	11,164	$2,151,544	(a)	(a)
1921	2,511	426,253	(a)	(a)
1922	3,977	593,128	1,616	$169,982
1923	5,024	743,577	1,485	176,624
1924	3,927	605,630	923	104,783

[a] Not classified separately prior to 1922.

Zinc oxide exported from the United States, 1923 and 1924

[Figures in parentheses not duplicated in totals]

Destination	1923		1924	
	Short tons	Value	Short tons	Value
Asia	68	$10,946	59	$10,186
Australia and Oceania	115	19,256	72	11,634
Philippine Islands	(49)	(8,036)	(64)	(9,474)
Canada	3,260	477,711	2,562	374,917
Cuba	42	9,934	28	6,466
Europe	1,188	153,451	794	114,591
France	(91)	(14,360)	(23)	(3,130)
Great Britain	(1,074)	(134,216)	(694)	(98,483)
Italy	(23)	(4,809)	(11)	(2,400)
Mexico	104	18,428	98	19,784
Panama	25	5,109	52	11,912
South America	149	31,554	191	40,183
Brazil	(14)	(2,986)	(38)	(7,460)
Other countries	73	17,188	71	15,957
	5,024	743,577	3,927	605,630

PRICES AND VALUE

The total value and the average price per ton received from sales of lead and zinc pigments and salts in 1924 are given on preceding pages of this chapter.

Figure 3 shows the relation of the average weekly price of lead in New York in 1924 to the weekly quotations on the lead pigments—sublimed lead, white lead, litharge, red lead, and orange mineral—

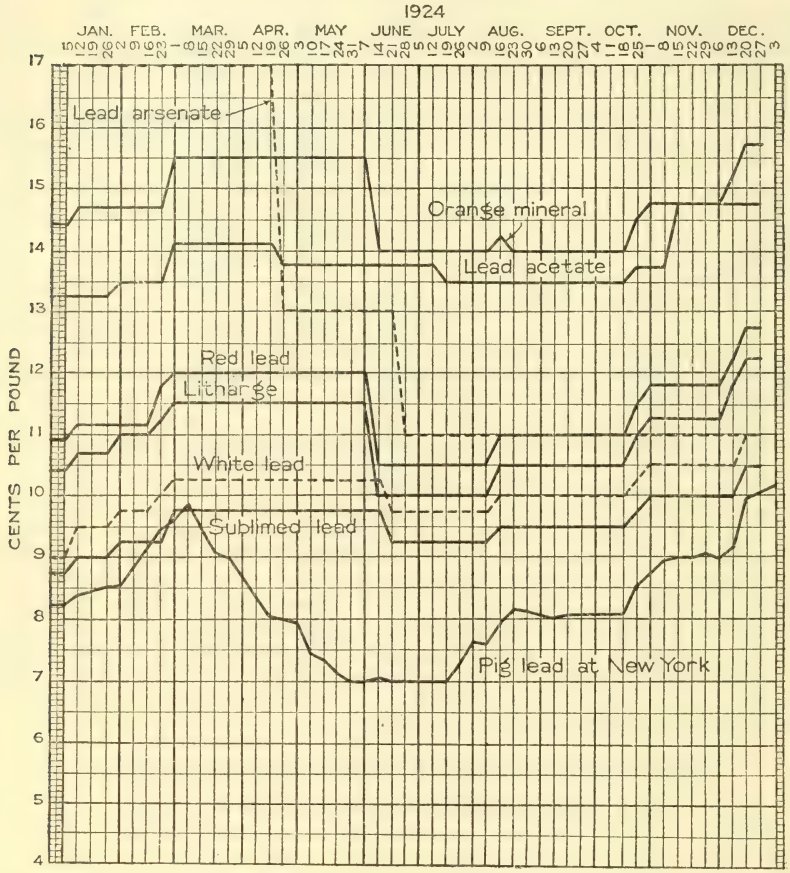

FIGURE 3.—Relation of weekly prices of lead pigments and salts to the average weekly quoted price of lead at New York, 1924

and the lead salts—lead arsenate and lead acetate. The quotations, taken from issues of the Oil, Paint, and Drug Reporter, represent the following grades and forms:

Sublimed lead, or basic lead sulphate (white), "in casks."
White lead, basic lead carbonate, "American, dry, in casks."
Litharge, "commercial, powdered, in casks."
Red lead, "dry, in casks."
Orange mineral, "American, in casks."
Lead acetate, "brown, broken, in barrels."
Lead arsenate, "paste, in barrels."

Figure 4 shows the relation of the average quoted price of prime western slab zinc in St. Louis to the weekly quotations on the pigments—zinc oxide and lithopone—and on the salts—zinc chloride

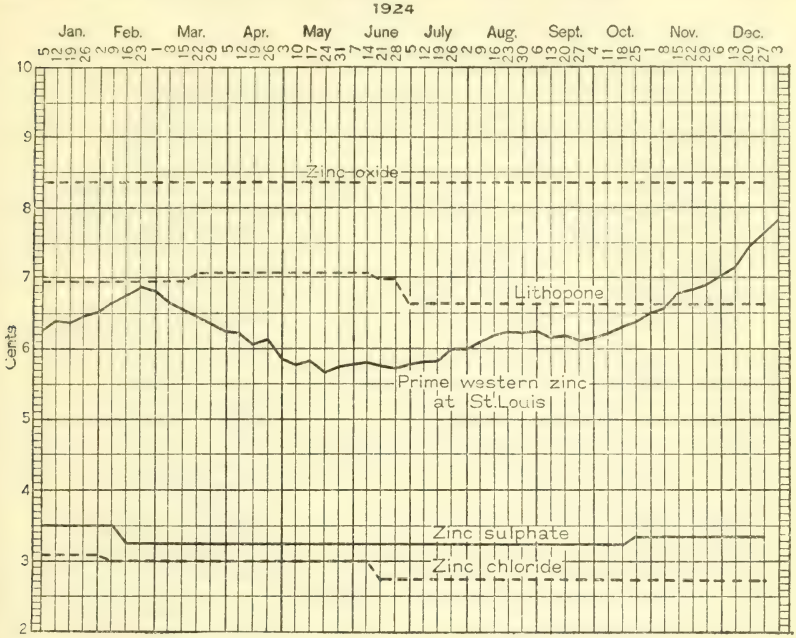

FIGURE 4.—Relation of weekly prices of zinc pigments and salts to the average weekly quoted price of prime western zinc at St. Louis, 1924

and zinc sulphate. The quotations, taken from issues of the Oil, Paint, and Drug Reporter, represent the following grades and forms:

Zinc oxide, "commercially lead-free, in barrels."
Lithopone, "in barrels."
Zinc chloride, "solution, in drums."
Zinc sulphate, "industrial, in barrels."

PRODUCERS

The following companies reported sales of lead and zinc pigments and zinc salts of their own production in 1924:

White lead:

Anaconda Lead Products Co. (electrolytic process)	East Chicago, Ind.
Carter White Lead Co	West Pullman, Chicago, Ill.
E. I. du Pont de Nemours & Co	Philadelphia, Pa.
Eagle-Picher Lead Co	East St. Louis, Ill.
Do	Cincinnati, Ohio.
Euston Lead Co	Scranton, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Matheson Lead Co	Long Island City, N. Y.
National Lead Co. of California	Melrose, Calif.
National Lead Co	Chicago, Ill.
Do	St. Louis, Mo.
Do	Brooklyn, N. Y.
Do	Port Richmond, N. Y.
Do	Cincinnati, Ohio.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.

White lead—Continued.	
United Lead Co	Perth Amboy, N. J.
Wetherill & Bro	Philadelphia, Pa.
Sublimed lead, or basic lead sulphate:	
Eagle-Picher Lead Co	Joplin, Mo.
St. Louis Smelting & Refining Works of National Lead Co	Collinsville, Ill.
Red lead, orange mineral, and litharge:	
Eagle-Picher Lead Co	East St. Louis, Ill.
Do	Joplin, Mo.
Do	Newark, N. J.
Do	Cincinnati, Ohio.
Evans Lead Co	Charleston, W. Va.
W. P. Fuller & Co	South San Francisco, Calif.
Grasselli Chemical Co	Grasselli, Ind.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Matheson Lead Co	Long Island City, N. Y.
National Lead Co. of California	Melrose, Calif.
National Lead Co	Chicago, Ill.
Do	St. Louis, Mo.
Do	Brooklyn, N. Y.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Pennsylvania Smelting Co	Carnegie, Pa.
Sherwin-Williams Co	Chicago, Ill.
Wetherill & Bro	Philadelphia, Pa.
Zinc oxide and leaded zinc oxide:	
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Bertha Mineral Co	Austinville, Va.
Eagle-Picher Lead Co	Hillsboro, Ill.
Empire Zinc Co	Canon City, Colo.
Grasselli Chemical Co	Grasselli, Ind.
International Lead Refining Co. (French process)	East Chicago, Ind.
Do. (French process)	Akron, Ohio.
Mineral Point Zinc Co	Mineral Point, Wis.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Do. (French process)	Freemansburg, Pa.
Ozark Smelting & Mining Co	Coffeyville, Kans.
River Smelting & Refining Co	Florence, Colo.
U. S. Zinc Co	Pueblo, Colo.
Western Zinc Oxide Co	Leadville, Colo.
Lithopone:	
Chemical & Pigment Co. (Inc.)	St. Helena, Md.
E. I. du Pont de Nemours & Co	Newark, N. J.
Do	Philadelphia, Pa.
Grasselli Chemical Co	Grasselli, N. J.
Krebs Pigment & Chemical Co	Newport, Del.
Midland Chemical Co. (Eagle-Picher Lead Co.)	Argo, Ill.
Mineral Point Zinc Co	Depue, Ill.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
St. Louis Lithopone Co	Collinsville, Ill.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc salts:	
American Zinc & Chemical Co	Langeloth, Pa.
Arkansas Preservative Co	North Little Rock, Ark.
By-Products Steel Corporation	Weirton, W. Va.
Charles Cooper & Co	Newark, N. J.
General Chemical Co	Chicago, Ill.
Grasselli Chemical Co	Grasselli, Ind.
Do	Cleveland, Ohio.
Great Western Electro-Chemical Co	Pittsburg, Calif.
Charles Lennig & Co. (Inc.)	Philadelphia, Pa.
Merrimac Chemical Co	Everett, Mass.
Monsanto Chemical Works	East St. Louis, Ill.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.

LEAD[1]

By C. E. Siebenthal and A. Stoll

SUMMARY

Statistics of refined lead, 1923 and 1924, in short tons

	1923	1924
PRODUCTION		
Domestic desilverized lead	291,760	299,343
Domestic soft lead	190,749	203,615
Domestic desilverized soft lead	61,332	63,449
	543,841	566,407
Foreign desilverized lead	74,481	124,086
Total refined primary lead [a]	618,322	690,493
Antimonial lead	14,190	20,787
Secondary lead [a]	194,490	204,500
CONSUMPTION [b]		
Apparent consumption of primary lead, refinery stocks disregarded	573,543	602,947

[a] "Primary lead," which is produced directly from ore, is here distinguished from "secondary lead," which is obtained by refining skimmings, drosses, and old metals. The statistics of secondary lead are given on p. 152. In this report the word "lead" used without qualification means primary lead.
[b] For method of calculating consumption see p. 164.

The output of refined lead in the United States from domestic ores in 1924 was 566,407 tons, valued at $90,625,000 at the average selling price of pig lead, a gain, as compared with 1923, of 4 per cent in quantity and of 19 per cent in value.

PRODUCTION

Quantity and value.—The total refined lead produced in the United States from 1720 to 1924 from domestic ores and from foreign ores and base bullion and its value are shown in the following table:

Refined lead produced in the United States, 1720–1924

Year	Short tons							Value	
	Desilverized lead [a] [b]	Desilverized soft lead	Soft lead [b]	Total production [a]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1720–1912	7,176,497	326,991	2,929,180	10,452,668	8,545,383	1,887,285			$924,600,000
1913	301,160	29,433	131,867	462,460	411,878	13,223	37,359	$0.044	40,696,000
1914	340,397	43,506	158,219	542,122	512,794	7,639	21,689	.039	42,286,000
1915	344,593	44,001	161,461	550,055	507,026	9,581	33,448	.047	51,705,000
1916	335,375	68,244	167,515	571,134	552,228	6,085	12,821	.069	78,817,000
1917	365,998	56,268	188,503	610,769	548,450	15,872	46,447	.086	105,052,000
1918	382,314	47,418	210,463	640,195	539,905	15,334	84,956	.071	90,908,000
1919	266,538	67,938	117,744	482,220	424,433	7,656	50,131	.053	51,115,000
1920	273,135	66,668	189,854	529,657	476,849	8,414	44,394	.080	84,745,000
1921	238,329	52,747	157,513	448,589	398,222	[c] 7,120	[c] 43,247	.045	40,373,000
1922	249,107	74,305	209,250	532,662	468,746	13,898	50,018	.055	58,593,000
1923	366,241	61,332	190,749	618,322	543,841	24,288	50,193	.070	86,565,000
1924	423,426	63,449	203,615	690,493	566,407	46,385	77,701	.080	110,479,000
	11,063,113	1,002,300	5,045,933	17,111,346	14,496,162	2,615,184			1,765,934,000

[a] The lead content of antimonial lead is excluded; see p. 151.
[b] Desilverized soft lead is excluded.
[c] Revised figures.

[1] Chapters on lead giving more than ordinary detail were published in Mineral Resources for 1908 (historical table of production) and 1918 (the lead industry in relation to the World War).

Details for years prior to 1913 are shown in the annual chapters. The value for years prior to 1917 is based upon the average price in New York; beginning with 1917 the value is based on the total sales of each producing company.

The argentiferous lead ores of the Western States are desilverized to recover the silver and to refine the lead. The nonargentiferous or soft lead ores of the Central and Eastern States do not carry enough silver on the average to pay for desilverizing or to make that operation necessary. For certain purposes, however, a considerable quantity of lead ore from southeast Missouri has been desilverized each year.

Production by States.—In addition to the domestic lead ores smelted in this country, small quantities of domestic lead ore have been exported to smelters in Canada. Ores from Washington yielded 1,388 tons of lead at Canadian smelters in 1918 and 3 tons in 1919, but no lead ore from the United States was treated in Canada in 1920–1924.

Primary lead smelted or refined in the United States, 1920–1924, by sources, in short tons

Source of ore	1920	1921	1922	1923	1924
Domestic ore:					
Alaska	591	773	324	400	582
Arizona	5,987	3,313	7,218	8,828	9,372
California	2,260	614	3,018	5,168	2,305
Colorado	17,752	12,104	11,108	23,885	25,491
Idaho	117,191	99,707	91,487	127,797	123,769
Illinois [a]	948	271	750	1,286	1,089
Kansas [a]	8,421	10,939	10,900	20,207	12,895
Kentucky [a]	114	41	73	66	201
Missouri [a]	171,999	151,028	202,245	169,323	191,501
Montana	13,231	11,565	14,551	18,345	21,226
Nevada	8,650	3,553	4,264	8,044	8,070
New Mexico	1,123	384	1,230	1,638	2,263
Oklahoma [a]	68,494	46,902	67,436	59,602	56,017
Oregon			37	47	
South Dakota	6	2	2		2
Tennessee [a]	2,705		751	1,020	985
Texas	1	1	5	40	27
Utah	64,006	51,872	63,130	104,678	119,318
Virginia [a]					1,582
Washington	2,460	325	478	2,008	2,057
Wisconsin [a]	3,841	1,079	1,323	601	1,973
Undistributed	201	101	75	691	15
Zinc residues	4,366	713	1,284	362	1,320
	494,347	395,287	481,689	554,036	582,000
Foreign ore:					
Africa	1,171			99	6
Australia	450				
Canada	1,186	2,877	3,604	3,632	4,633
Central America	22	6	14	18	30
Europe	19	17	519	139	328
Mexico	2,729	1,912	7,260	18,867	33,328
South America	2,747	2,235	2,458	1,461	7,663
Other foreign	90	73	43	72	897
Foreign base bullion:					
Canada	1,919	1,599	2,900		
Mexico	42,421	41,648	47,118	50,193	77,701
South America	54				
	52,808	50,367	63,916	74,481	124,086
Grand total	547,155	445,654	545,605	628,517	706,086

[a] The lead produced by these States is nonargentiferous or soft lead. A small quantity of the lead produced from Colorado and New Mexico ores is also nonargentiferous.

Soft lead.—The lead ores of the Mississippi Valley are almost free from silver, and the lead produced from them is known as soft lead. The output of the lead pigment basic lead sulphate or sublimed lead is derived from these ores.

The lead ores from the southeastern Missouri district contain a little more silver (slightly over an ounce to the ton of concentrates in all) than those from other regions of the Mississippi Valley, and likewise small quantities of other metals, so that the unrefined lead, though soft, is resistant to acids and is much in favor for sulphuric acid chambers. It is known to the trade as "chemical lead."

Soft lead produced in the United States from domestic ores, 1920–1924, in short tons

Year	Soft pig lead			Soft lead recovered in pigments	Total soft lead	Total domestic lead [a]	Soft lead percentage of domestic lead
	Undesilverized	Desilverized	Total				
1920	189,854	66,668	256,522	15,212	271,734	500,093	54
1921	157,513	52,747	210,260	9,989	220,249	414,886	53
1922	209,250	74,305	283,555	13,892	297,447	488,448	61
1923	190,749	61,332	252,081	13,612	265,693	567,247	47
1924	203,615	63,449	267,064	15,338	282,402	593,486	48

[a] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

The zinc ores from Western States that are made into pigments may contain some lead which goes into the pigment, and therefore it is not strictly accurate to speak of the lead content of pigments as entirely soft lead.

In addition to the domestic lead so recovered, some foreign lead is also recovered in pigments. Prior to 1919 this foreign lead was not distinguished from that of domestic origin. In 1919 the quantity of foreign lead recovered in zinc pigments was 351 short tons; in 1920, 808 tons; in 1921, 169 tons; and in 1924, 545 tons. No foreign lead was used in pigments in 1922 or 1923.

Antimonial lead.—The production of by-product antimonial lead from argentiferous lead ores derived from all sources, as reported by all lead refineries operating in this country, is shown for the period 1871–1914 in Mineral Resources, 1914, and for 1915–1920 in Mineral Resources, 1920.

By-product antimonial lead produced in the United States, 1920–1924

Year	Total lead refined from base bullion (short tons)	Percentage of by-product antimonial lead	Antimonial lead						
			From domestic ore (short tons)	From foreign ore (short tons)	Total				
					Short tons	Value	Antimony content		Lead content, by difference (short tons)
							Short tons	Percentage	
1920	273,135	4.6	9,604	2,931	12,535	$1,963,255	2,033	16.2	10,502
1921	238,329	4.2	7,881	2,183	10,064	870,059	1,589	15.8	8,475
1922	249,107	3.2	7,068	1,007	8,075	844,993	1,441	17.8	6,634
1923	366,241	3.9	11,635	2,555	14,196	1,950,370	2,170	15.3	12,020
1924	423,429	4.9	13,593	7,194	20,787	3,376,713	2,763	13.3	18,024
Average		4.2						15.2	

Lead pigments.—Leaded zinc oxide, zinc-lead oxide, sublimed white lead, and sublimed blue lead are made directly from ore; white lead, red lead, orange mineral, and litharge are manufactured from pig lead. These pigments are discussed and their output given elsewhere in this volume in the chapter on lead and zinc pigments and salts.

The lead recovered from domestic and foreign ore in the form of pigments during recent years is given in the following table, which also gives the primary and secondary lead used in making those pigments that are made from pig lead:

Quantity and source of lead in pigments,[a] 1920–1924, in short tons

Year	Domestic ore	Foreign ore	Primary metal [b]	Secondary metal [b]
1920	15,212	808	215,431	----------
1921	9,989	169	200,599	----------
1922	13,892	----------	241,096	111
1923	13,612	----------	236,541	----------
1924	15,338	545	250,930	----------

[a] Includes lead recovered in zinc oxide and leaded zinc oxide.
[b] Primary metal is that made from ore; secondary metal is that derived from old metal and from drosses and skimmings.

Secondary lead.—Secondary lead is obtained mainly from skimmings, drosses, old metal, and alloys, such as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral part of the lead industry.

Secondary lead recovered in the United States, 1920–1924, in short tons

Year	Pig lead	Lead in alloys	Total recovered lead	Value
1920	56,350	68,300	124,650	$19,944,000
1921	46,370	57,410	103,780	9,340,000
1922	75,480	84,080	159,560	17,552,000
1923	96,430	98,060	194,490	27,229,000
1924	90,400	114,100	204,500	32,720,000

Mine production.—The preceding tables give the quantity of lead recovered by smelting and refining operations either as metallic lead, or in the alloy antimonial lead, or as lead in pigments. The origin of the lead is much more accurately shown by the reports of mines, because smelters necessarily treat mixtures of ores, sometimes long after they have been received, so that the actual output of metallic lead may not correspond at all closely to the product of the mines for the same year.

The following table gives the mine output of lead from 1920 to 1924, inclusive. The statistics of mine production, which for years prior to 1921 had been expressed as lead content of ore mined, were reduced to recoverable lead in the chapter on lead for 1923 by deducting an assumed loss in smelting and refining, thus making the figures comparable to the statistics of mine production of zinc, which have always been stated as recoverable zinc. In these calculations the loss

in smelting and refining has been taken as 2 per cent in smelting (at plants with bag houses) the soft nonargentiferous lead ores of the Mississippi Valley, and about 5 per cent in smelting and refining the argentiferous lead ores of the Western States. That these assumed factors are close to the truth is shown by the small discrepancy between the mine and smelter output totals as disclosed in the table of comparison on page 136 of the chapter on lead in Mineral Resources, 1923, and in the following section.

Mine production of recoverable lead, 1920–1924, by States, in short tons

State	1920	1921	1922	1923	1924
Alaska	875	759	377	410	631
Arizona	6,935	3,271	7,535	8,146	9,321
Arkansas	8	21	42	25	20
California	2,407	562	3,156	4,775	2,382
Colorado	23,315	9,830	11,739	22,849	23,779
Georgia	2		4		
Idaho	118,565	99,235	97,917	121,178	124,475
Illinois	1,708	672	1,325	1,381	1,464
Kansas	16,452	18,679	23,271	17,598	18,560
Kentucky	120	69	92	53	175
Massachusetts	14				(a)
Missouri	161,812	180,085	178,412	169,743	189,929
Montana	14,846	10,183	14,884	17,973	19,738
Nevada	10,100	3,594	4,695	9,078	10,030
New Mexico	1,435	339	1,506	1,916	1,817
Oklahoma	64,086	41,552	62,856	66,904	71,358
Oregon			38	14	(b)
Pennsylvania	7				
South Dakota	6	2			
Tennessee	1,880		732	1,250	937
Texas			4	13	
Utah	66,898	44,594	67,666	101,724	116,955
Virginia					1,275
Washington	2,749	72	691	1,453	1,968
Wisconsin	2,594	972	691	734	1,254
	496,814	414,491	477,633	547,217	596,068

[a] It is said that a few tons of lead ore were mined at the old Chipman mine in Massachusetts, and were treated at a small smelter owned by the mine operators.
[b] 513 pounds.

The following table lists the principal lead-producing districts in the order of magnitude of their output in 1916. It shows annual production during the period beginning in that year, when war-time production took its stride, and continuing down through 1924, when the production of domestic lead ores was again nearly back to the peak. It shows the fluctuation in the output of the several districts and demonstrates the security of the southeastern Missouri region in first place and of the Coeur d'Alene region in second place.

The figures by districts for years prior to 1921 have also been reduced in the following table to recoverable lead in the ore mined, as explained above.

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1916–1924, in short tons

District	1916	1917	1918	1919	1920	1921	1922	1923	1924
Southeastern Missouri region	197,599	200,454	177,764	154,015	158,033	178,735	176,768	167,458	187,737
Coeur d'Alene region, Idaho	169,211	176,704	132,342	79,641	112,200	94,543	91,216	114,426	118,327
Joplin region (Kansas, Missouri, and Oklahoma)	44,315	57,814	74,609	69,861	84,317	61,581	87,771	86,787	92,110
Bingham, Utah	40,848	34,924	37,893	25,940	24,932	12,288	19,348	25,353	34,786
Tintic, Utah	18,665	16,662	14,560	11,620	19,589	18,158	23,646	38,906	40,674
Park City region, Utah	15,786	16,015	11,552	10,123	12,223	8,846	16,129	26,220	33,346
Leadville, Colo	10,755	8,922	11,187	5,638	4,279	1,762	2,742	2,804	4,795
San Juan Mountains, Colo	9,486	11,178	10,252	8,003	13,522	5,323	5,332	13,157	13,149
Aspen, Colo	8,760	7,176	5,833	2,655	2,235	1,198	1,778	1,486	455
Ophir, Utah	6,109	4,551	4,340	3,984	3,628	480	2,921	3,443	1,414
Butte, Mont	4,368	4,917	10,804	9,648	8,355	6,614	10,070	12,745	13,648
Upper Mississippi Valley region (Iowa, northern Illinois, and Wisconsin)	3,449	4,672	5,827	5,703	3,384	1,506	1,259	948	1,639
	529,351	543,989	496,963	386,831	446,697	391,034	438,980	493,733	542,080
Percentage of United States total mine production	88	87	88	90	90	94	92	90	91

COMPARISON OF MINE AND SMELTER TOTALS

The Geological Survey published annually from 1907 to 1920 the statistics of lead output by mines, but because of lack of knowledge of the average smelting loss for the whole country, the total was, in general, given as lead content of ore mined, not as recoverable lead. Beginning with 1921, the lead output of the mines has been expressed as recoverable lead by estimating as closely as possible the losses in smelting and refining. For the sake of the following comparison the mine totals for 1906 to 1920 have likewise been calculated as recoverable lead. In addition to the domestic lead recovered at smelters as refined desilverized lead from argentiferous ores, as soft lead from Mississippi Valley ores, and as lead in antimonial lead and in pigments, considerable lead has been recovered at Canadian smelters from lead ores exported from the United States. This is included in the recovered lead given in the table below, which balances the primary lead recovered in all forms against the estimated recoverable lead in the ore mined for 18 years, the whole period for which such data are available.

Domestic primary lead balance sheet, 1907–1924, in short tons

Year	Recoverable lead (mine production)	Recovered lead (smelter production)	Mine excess (+) or smelter excess (−)	Year	Recoverable lead (mine production)	Recovered lead (smelter production)	Mine excess (+) or smelter excess (−)
1907	364,715	365,506	−791	1917	628,464	578,925	+49,539
1908	330,237	326,657	+3,580	1918	562,402	563,606	−1,204
1909	385,113	367,393	+17,720	1919	429,589	443,954	−14,365
1910	382,692	391,543	−8,851	1920	496,814	500,093	−3,279
1911	426,585	407,767	+18,818	1921	414,491	414,886	−395
1912	442,126	410,228	+31,898	1922	477,633	488,448	−10,815
1913	483,113	435,474	+47,639	1923	547,217	567,247	−20,030
1914	504,769	537,696	−32,927	1924	596,068	593,486	+2,582
1915	542,098	536,355	+5,743				
1916	601,392	582,180	+19,212		8,615,518	8,511,444	+104,074

SUPPLY OF LEAD

The future of the lead industry depends on the price of lead, the latter on supply and demand, and the supply in turn on the yield of new and old fields as well as on higher recovery through advances in metallurgical methods; these of course have always been the determining factors in the industry, although imaginary factors have played their part in speculative movements. Relief from a scarcity of lead may therefore be afforded by discovery of new ore supplies; improvement in separation and concentration, by which grades of ore hitherto unworkable are added to the country's or world's supply; better methods in reduction, which accomplish the same object by cheapening the cost of reduction or by effecting a separation of metals in the process of reduction; and lessening of demand either by its partial cessation or by substitution of other metals.

The price of lead has fluctuated greatly in the last two years, owing to the opportunity for speculation offered by the scarcity of spot lead at times. These fluctuations have unsettled both the producing and the consuming branches of the lead industry and have aroused fears for the adequacy of the future lead supplies of the country. Of course, a temporary shortage of pig lead no more indicates that the lead reserves of the country are failing than a partial failure of the wheat or corn crop indicates that the fertility of the soil is waning. When production runs behind consumption, however, and a greater supply is necessary, it takes time and capital to find and open new deposits and to reopen old mines, and without constancy of price only the experienced, farseeing, strongly financed companies will undertake such work. The smaller, weaker companies will remember that though lead averaged 8 cents a pound in 1924 and has averaged 6.8 cents for 1916 to 1924, inclusive, yet the average for 1921 was 4.5 cents, the same as the pre-war average for 1900 to 1915. Many promising prospects and mines must have been closed down and the operating companies wiped out in 1921 by pre-war receipts for their product and high postwar costs of operation, but there is yet hope that some of them will be reopened.

If the price of lead could remain steadily at the average for 1924, no one need doubt that our production would soon rout any fears of a scarcity of spot lead. If lead had no more than kept pace in price with the average of metals and metal products since 1913, it would have sold in 1924 for about 6.9 cents.[2] If it had kept pace with the average of all commodities it would have sold at an average of 6.6 cents in 1924; if with agricultural products, at 6.9 cents; if with nonagricultural products, at 7.2 cents; and with the cost of living, at 7.6 cents. It would seem, therefore, that in comparison with other commodities (except, of course, copper and zinc) 8 cents a pound, the average for 1924, is not unfair.

The present situation with regard to the lead supply is briefly this: The United States and Mexico produced more lead in 1924 than ever before. Canada has quadrupled her output since the war and is still expanding her capacity. Australia's output has for two years been well up toward her large war-time production. The chief reserves upon which Australia and Canada are drawing have

[2] Bureau of Labor Statistics, Monthly Labor Review, Department of Labor; vol. 20, 1925, pp. 54–78.

been recently said to be equal to about 20 years' draft at the present rate. Moreover, a new field is under development in Queensland, and a concentrating method is being sought for the extensive Read-Rosebery complex ores of Tasmania. The Burma output has nearly trebled since the war and the reserves are equal to nearly 20 years' output at the present rate, disregarding current additions to reserves by mine operations. The output from other sources of lead in Africa, Asia, and South America remains about stationary, but Europe is approximately 220,000 tons short of her pre-war production, chiefly because of the lessened output of Spain, Germany, and Poland. Apparently, the Old World misses the efficient ore-gathering machine of the German metal companies. The world's production in 1924 was the largest in history by over 125,000 metric tons, according to the American Bureau of Metal Statistics.

Residence and business building has been extremely active in this country ever since the World War, and has required supplies of plumbing and other lead material. Such construction was needed not only to accommodate the great expansion of business immediately after the war but also to catch up with current needs and with arrears in residence building. Dow's Agency recently noted that apartment building is threatened with overproduction in certain directions, and continuing the erection of business buildings is, of course, contingent upon continued business prosperity. The automobile industry consumes much lead, but the saturation point in that industry must be reached eventually, and then the salvaged lead will practically equal the consumption of new lead. There is, moreover, a pronounced trend toward the use of less lead. A substitute for lead in underground cable coverings will probably be found. Moreover, encouraging experiments are under way on reduction in the size of individual cable wires as well as in the amount of insulating material, which will permit many more wires in the same space and reduce the consumption of lead for cable covering. Recently a radio tube has been put on the market which uses alternating current, where that is available, instead of the more usual storage battery or the occasional step-down transformer on external direct-current supply. Transformers and rectifiers which eliminate "B" batteries (some of which are lead storage-batteries) have been in use for some time. There is now a tendency to make the ordinary tube set more portable by replacing lead storage-batteries with dry batteries which use no lead.

According to the American Bureau of Metal Statistics, storage batteries (all kinds, of course) consumed the largest amount, about 170,000 short tons, of lead in 1924; white lead took 150,000 tons; and cable covering, 138,000 tons. France, Soviet Russia, and Argentina have legislation, not yet in effect, restricting the use of white lead, hence legal measures or economic necessity might force substitution of other white pigments for part of the lead used in white lead. The examples of lead conservation cited show that the rapidly increasing consumption of lead in the immediate past may not continue indefinitely. Lastly, attention is again called to the 100,000 tons of lead in ore, matte, and bullion in bonded warehouse, December 31, 1924.

METALLURGY

ADVANCE IN METALLURGY

Recent advances in the separation and concentration of complex ores have been made possible mainly by refinements in flotation, especially differential flotation, but also by various special methods of roasting and leaching or volatilization. These improvements promise to be important to the lead industry because their successful employment will increase the supply of lead by allowing better recovery of lead from ore, and especially by making available low-grade deposits of complex sulphides or mixed sulphide and oxidized ores heretofore unworkable, some because of the penalty exacted for the zinc content, which may thus become an asset.[3]

The present movement for more effective concentration practically started at the Sullivan mine in British Columbia, where the Consolidated Mining & Smelting Co. after much experimenting succeeded by differential flotation in overcoming the obstacles to clean separation and saving of the lead and zinc in the ore of what is reputed to be the largest sulphide ore body in North America. After this success in treating the ores the company largely increased the capacity of the lead smelter and the electrolytic zinc plant, and constructed a custom plant which pays miners for the zinc content of complex ores. A plant accomplishing the same results was built by the International Smelting Co. at Tooele, Utah; a similar plant has been started by the United States Smelting Co., at Midvale, Utah; and still others have been built by individual mining companies. Operation of such plants increases the supply of lead because greater quantities of the lower-grade ores come into the market.

No attempt will be made to discuss the advantages or shortcomings of the proposed roasting, leaching, or volatilization processes, but it seems advisable to review a few processes which have been installed commercially.

The Coolbaugh process, now operated by the American Smelting & Refining Co. in connection with its lead smelter at Durango, Colo., by a closely controlled roast renders a high percentage of the zinc blende leachable as zinc sulphate; the residues are suitable for treatment in the lead smelter. It has not yet been settled whether the market outlet for the zinc sulphate will be as zinc sulphate or lithopone, lead-free zinc oxide, or electrolytic zinc.

At Harold, Utah, the Tintic Standard Mining Co. uses the Holt-Dern process for an oxidized silver-lead ore. The ore is blast roasted with salt and coal dust and leached with brine; silver, copper, and finally lead are precipitated separately. The lead precipitate is melted into refined lead bars in a suitable furnace which made its initial output in 1924.

The Combined Metals Reduction Co., a subsidiary of the National Lead Co., is using the Snyder-Christensen process at Bauer, Utah. The finely ground unroasted lead concentrates are leached with hot acid brine, silver is precipitated by lead, and lead is precipitated by

[3] The following papers will be found useful in reviewing this metallurgical advance: Ralston, O. C., "Hydrometallurgy of lead": Trans. Am. Inst. Min. and Met. Eng., vol. 70, 1924, pp. 447–470. Oldright, G. L., "Present tendencies in treatment of complex ores": Trans. Am. Inst. Min. and Met. Eng., vol. 70, 1924, pp. 471–485. Parsons, A. B., "Progress in hydrometallurgy of lead-zinc ores": Eng. and Min. Jour.-Press, vol. 119, 1925, pp. 55–61.

cooling the liquor and is reduced to bars by melting with a mixture of lime and coal dust. As the ore is worked at Bauer the zinc is mainly floated in concentration, but any zinc remaining in solution is precipitated by H_2S and filtered off for electrolytic reduction or shipment to zinc smelters.

At the Bunker Hill & Sullivan Mining & Concentrating Co., U. G. Tainton and others have developed a process for the treatment of the zinc-lead ore from the Star mine. The ore is roasted and leached, the zinc recovered by Tainton's "high-acid" process, and the leady residues leached with brine and precipitated electrolytically. The contracting of the Star mine's zinc concentrates to Belgian smelters, as recently announced, may delay the construction of a commercial plant employing these Tainton processes.

It is to be noted that these methods of brine leaching are applicable not only to the complex ores, both sulphide and oxidized, from the mines and to tailings and middlings from their concentrating plants, but also to tailings from electrolytic zinc plants, to leady flue dusts, and to leady sludges from sulphuric acid chambers, and the like. In this adaptability lies much of their promise.

LEAD SMELTERS AND REFINERIES

UNITED STATES

California:
- Selby—Selby plant, American Smelting & Refining Co. Refinery also.

Colorado:
- Durango—Durango plant, American Smelting & Refining Co.
- Leadville—Arkansas Valley plant, American Smelting & Refining Co.

Idaho:
- Kellogg—Bunker Hill & Sullivan smelter. Refinery also.

Illinois:
- Chicago—Goldsmith Bros.' Smelting & Refining Co.[4]
- Chicago—Great Western Smelting & Refining Co.[4]
- Chicago—Illinois Smelting & Refining Co.[4]
- Chicago—U. S. Reduction Co.[4]
- Collinsville—St. Louis Smelting & Refining Works of National Lead Co. Refinery also.
- Federal—American Smelting & Refining Co. (Formerly Federal Lead Co.)

Indiana:
- East Chicago—International Lead Refining Co.[5] Refinery only.
- Grasselli—U. S. S. Lead Refinery (Inc.).[6] Refinery only. Betts electrolytic process.

Kansas:
- Galena—Galena plant, Eagle-Picher Lead Co.

Missouri:
- Granby—American Zinc, Lead & Smelting Co.
- Herculaneum—St. Joseph Lead Co.
- Joplin—Eagle-Picher Lead Co.

Montana:
- East Helena—East Helena plant, American Smelting & Refining Co.

Nebraska:
- Omaha—Omaha plant, American Smelting & Refining Co. Refinery only. Betts electrolytic process.

New Jersey:
- Irvington—Irvington Smelting & Refining Co.[4]
- Newark—Balbach Smelting & Refining Co.
- Perth Amboy—Perth Amboy plant, American Smelting & Refining Co.

Oklahoma:
- St. Louis—Ontario smelter, Eagle-Picher Lead Co.

[4] Smelters of secondary materials but treating some lead ores.
[5] Subsidiary of Anaconda Copper Mining Co.
[6] Subsidiary of the United States Smelting, Refining & Mining Co.

Pennsylvania:
Carnegie—Pennsylvania Smelting Co. Refinery also.
Texas:
El Paso—Kansas City Consolidated Smelting & Refining Co.[7]
Utah:
Harold—Tintic Standard Mining Co.
International—International Smelting Co.[8]
Midvale—United States Smelting, Refining & Mining Co.
Murray—Murray plant, American Smelting & Refining Co.

CANADA

British Columbia:
Trail—Consolidated Mining & Smelting Co. of Canada (Ltd.). Refinery also. Betts electrolytic process.
Ontario:
Galetta—Estate of Jas. Robertson.

MEXICO

Aguascalientes:
Aguascalientes—American Smelting & Refining Co.
Chihuahua:
Chihuahua—American Smelting & Refining Co.
Coahuila:
Saltillo—Mazapil Copper Co. (Ltd.).
Torreón—American Metal Co. (Ltd.). (Cia. Metalúrgica de Torreón.)
Durango:
Asarco (Velardeña)—American Smelting & Refining Co. (Cia. Minera Asarco.)
Guerrero:
Campo Morado—Reforma Mining & Milling Co.
Nuevo Leon:
Monterrey—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S. A.) Refinery also.
Monterrey—American Smelting & Refining Co.
San Luis Potosi:
Matehuala—American Smelting & Refining Co. (Cia. Minera Asarco.)
San Luis Potosi—American Smelting & Refining Co. (Cia. Minera Asarco.)

TRADE CONDITIONS

WORLD'S SMELTER PRODUCTION

In the following table, prepared by W. I. Whiteside, of the Bureau of Mines, the figures in italic type are taken from the official statistics of the countries named; those in ordinary type are taken from the yearbook of the American Bureau of Metal Statistics, and from other sources regarded as reliable. However, the official statistics will be substituted when they are available, as it is desirable to have an official set of statistics of world production as well as an independent set like that of the American Bureau of Metal Statistics.

There is always a possibility of duplication in figures showing world's production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are often included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

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[7] Subsidiary of American Smelting & Refining Co.
[8] Subsidiary of Anaconda Copper Mining Co.

World's production of lead, 1918–1924

[In metric tons, by countries where smelted, but not necessarily refined. Figures in italic type are official]

Country	1918	1919	1920	1921	1922	1923	1924
Australia	*163,376*	*83,408*	*5,474*	*51,452*	*105,126*	*132,165*	127,600
Austria	*4,743*	*1,764*	*3,973*	*3,347*	*3,360*	*4,255*	*4,985*
Belgium	*20,630*	*4,225*	*16,040*	*29,760*	*43,580*	*51,100*	53,700
Canada	*17,005*	*16,143*	*13,733*	*28,274*	*40,191*	*46,801*	*75,987*
Chosen	*264*	*653*	*585*	(a)	(a)	(a)	(a)
Czechoslovakia	(a)	*2,963*	*2,006*	*2,388*	*2,228*	*2,452*	*2,264*
France	*12,778*	*10,928*	*15,060*	*15,475*	*13,944*	17,413	21,000
Germany:							
Upper Silesia	*23,960*	*18,580*	*18,008*	*13,743*	[b] *6,188*	(c)	(c)
Other Germany	*40,617*	*39,006*	*52,495*	*70,487*	59,100	35,000	45,000
Great Britain	11,083	10,441	11,136	2,474	5,036	6,815	5,388
Greece	*4,093*	*3,841*	*5,016*	*5,575*	*4,408*	*4,235*	*5,106*
India (Burma)	*19,380*	*19,396*	*24,203*	*34,258*	*39,843*	*46,799*	*51,370*
Italy	*18,332*	*16,530*	*15,947*	*12,494*	*10,710*	*17,131*	*22,062*
Japan	*10,684*	*5,771*	*4,167*	*3,138*	*3,239*	*2,700*	*2,941*
Mexico	83,705	76,384	82,480	58,586	114,235	121,607	131,113
Norway						*242*	*642*
Poland:							
Upper Silesia	(d)	(d)	(d)	(d)	[e] *8,325*	*16,256*	*16,205*
Other Poland	(a)	*636*	1,500	*1,010*	*50*		(a)
Rhodesia	*9,935*	*12,859*	*14,836*	*17,969*	*20,829*	*11,197*	*5,999*
Rumania	(a)	*544*	*601*	*582*	*477*	(a)	*433*
Russia	(a)	(a)	(a)	(a)	394	555	[f] *625*
South America	4,781	6,565	6,264	4,664	5,939	5,081	11,612
Spain	*169,709*	*125,721*	*175,196*	*135,881*	*119,451*	*127,514*	*141,849*
Sweden	*2,241*	*827*	*863*	*513*	*315*	*223*	*536*
Tunisia	*16,533*	*5,800*	*11,407*	*12,225*	*14,552*	*14,090*	*14,291*
Turkey	2,500	1,000	1,000	8,345	5,400	1,400	5,104
United States (refined)	*503,702*	*391,982*	*440,221*	*367,718*	*437,845*	*515,395*	*555,913*
Yugoslavia	(a)	*5,727*	*5,099*	*4,828*	*8,497*	*9,260*	*11,487*
Known production	1,140,000	862,000	927,000	885,000	1,073,000	1,190,000	1,313,000

[a] Data not available.
[b] First six months; for second six months, see Poland.
[c] See Poland.
[d] See Germany.
[e] Second six months; for first six months, see Germany.
[f] Data for operating year Oct. 1, 1923, to Sept. 30, 1924.

IMPORTS AND EXPORTS

The following tables were compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the Bureau of Mines.

Lead remaining in warehouse in the United States, December 31, 1920–1924, in pounds

[Stated in the form in which the material was entered for warehouse]

	1920	1921	1922	1923	1924
Ore	32,923,299	13,679,465	10,470,144	76,031,259	103,474,370
Base bullion	69,517,026	24,692,350	7,076,544	80,306,856	95,007,016
Pigs, bars, and old	2,644,576	693,440		5,234,475	10,090,668

Lead imported for consumption in the United States, 1920–1924

Year	Lead in ore [a]		Base bullion		Pigs, bars, and old [b]		Sheets, pipe, and shot		Not otherwise specified	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1920	13,700,499	$908,619	66,816,820	$3,340,600	68,901,959	$3,887,821	81,396	$5,483	$21,328	$8,163,851
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,716	3,087	140	11,204	3,979,516
1922	[a]23,649,851	812,603	55,859,422	1,815,142	[b] 8,563,110	[b] 335,924	6,018	697	12,286	2,976,652
1923	[a]22,420,046	1,190,414	11,124,151	626,201	[b]42,925,265	[b]2,510,466	19,525	4,495	90,027	4,421,603
1924	[a]65,147,976	3,145,791	28,796,402	1,542,167	[b]27,362,392	[b]1,850,862	11,666	4,384	138,637	6,681,841

[a] Includes also lead in matte beginning Sept. 22, 1922.
[b] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., beginning Sept. 22, 1922.

Type metal imported for consumption in the United States, 1920–1924

Year	Type metal		Lead content	
	Pounds	Value	Pounds	Percentage
1920	29,887,353	$1,349,495	25,761,543	86.2
1921	38,971,351	1,191,553	30,706,845	78.8
1922	44,895,120	1,120,814	33,944,199	75.6
1923	[a]	[a]	7,353,463	[a]
1924	[a]	[a]	1,288,766	[a]

[a] Figures not available.

General imports of lead into the United States, 1920–1924, by classes, in pounds

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1920	29,488,816	96,103,603	71,437,108	197,029,527
1921	14,234,039	71,733,838	62,602,534	148,570,411
1922	24,474,481	124,074,465	7,101,623	155,650,569
1923	66,882,850	161,496,495	42,198,848	270,578,193
1924	95,320,168	155,501,350	24,493,746	275,315,264

General imports of lead into the United States, in ore, base bullion, and refined, 1920–1924, by sources, in pounds

Year	Canada	Mexico	South America	Europe	Other countries	Total
1920	8,199,234	131,815,278	7,085,351	38,766,504	11,163,160	197,029,527
1921	8,127,158	106,406,238	2,381,365	30,224,701	1,430,949	148,570,411
1922	8,663,236	141,216,136	3,803,478	1,454,384	513,335	155,650,569
1923	11,399,671	242,352,788	5,300,161	11,004,938	520,635	270,578,193
1924	11,022,091	243,161,069	15,820,867	4,857,805	453,432	275,315,264

The high price of lead shortly before and during the World War made it profitable to export domestic lead. Beginning in March, 1914, the exports soon reached large quantities, but they declined rapidly after the war.

Refined lead, made from domestic ores, exported from the United States, 1915–1924

Year	Short tons	Value	Year	Short tons	Value
1915	88,306	$7,928,518	1920	2,730	$462,223
1916	100,500	13,494,065	1921	1,624	177,926
1917	53,688	9,560,598	1922	5,823	604,605
1918	41,831	5,889,381	1923	1,999	260,487
1919	10,510	1,471,256	1924	5,332	711,147

The lead of foreign origin which has been smelted, refined, or manufactured in this country and then shipped abroad is shown in the following tables.

Foreign lead exported from the United States, 1920–1924

Year	Exported from warehouse			Exported in manufactures with benefit of drawback (pounds)
	Pigs, bars, and old [a]		All other manufactures	
	Pounds	Value		
1920	34,725,501	$2,570,535	$35,146	12,350,794
1921	50,000,259	2,284,107	613	18,738,927
1922	64,709,305	3,177,360	146	11,354,070
1923	97,471,326	5,195,256	[b]	25,052,107
1924	153,515,863	9,685,619	[b]	30,549,116

[a] Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has classed all foreign lead smelted or refined in this country and exported as "domestic exports of pigs, bars, etc., produced from foreign ore." The above figures include also the exports of foreign lead imported in the form of pigs and bars.
[b] Not separately classified after 1922.

Domestic and foreign pig lead exported from the United States, 1923–24, by destinations

[Figures in parentheses are not duplicated in the totals]

Destination	Domestic		Foreign	
	Short tons	Value	Short tons	Value
1923				
Asia	124	$12,950	2	$144
Japan	(112)	(10,976)		
Philippine Islands	(8)	(1,104)	(2)	(144)
Canada	126	23,594	1	128
Cuba	104	15,313	62	6,725
Europe	690	80,852	45,547	4,843,659
Denmark			(224)	(24,034)
France	(336)	(36,964)	(10,335)	(1,078,051)
Germany	[a]	(17)	(6,611)	(685,831)
Great Britain	(185)	(25,171)	(21,248)	(2,316,482)
Netherlands	(112)	(12,322)	(4,348)	(460,457)
Mexico	96	17,821	48	6,047
South America	743	90,669	3,074	338,329
Argentina	(384)	(41,602)	(843)	(94,665)
Brazil	(257)	(32,323)	(1,942)	(211,433)
Uruguay	(34)	(3,829)	(284)	(31,553)
Panama	58	9,254	[a]	42
Other countries	58	10,034	2	182
	1,999	260,487	48,736	5,195,256
1924				
Asia	33	5,650	2,353	287,397
Japan			(2,072)	(256,427)
Philippine Islands	(30)	(5,037)	(1)	(158)
Canada	120	23,476	[a]	56
Cuba	105	17,308	126	16,220
Europe	3,870	483,571	70,271	8,870,351
France	(1,116)	(130,356)	(10,899)	(1,400,908)
Germany			(10,069)	(1,210,009)
Great Britain	(2,096)	(274,902)	(38,063)	(4,887,487)
Netherlands	(588)	(69,893)	(2,340)	(288,780)
Mexico	45	10,569	35	4,677
South America	1,066	153,217	3,958	504,084
Argentina	(695)	(87,584)	(1,327)	(164,065)
Brazil	(250)	(43,036)	(2,418)	(312,471)
Uruguay	(3)	(571)	(140)	(17,547)
Panama	39	6,477		
Other countries	54	10,879	15	2,834
	5,332	711,147	76,758	9,685,619

[a] Less than 1 ton.

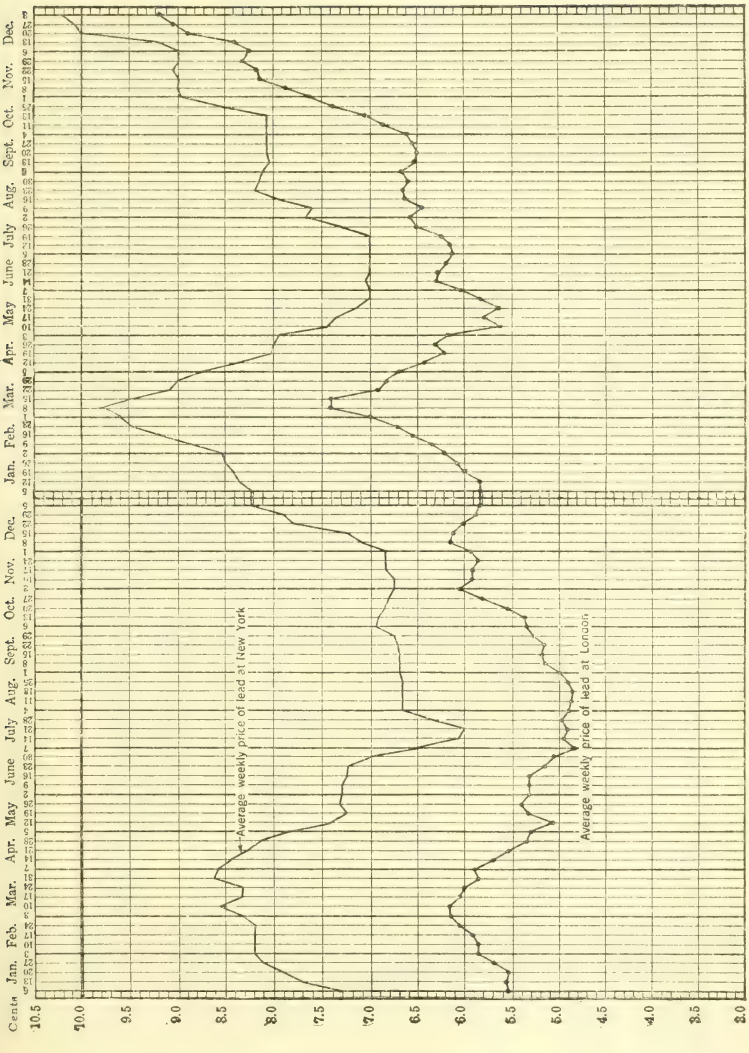

FIGURE 5.—Average weekly quoted price of lead at New York and London, 1923-24, with fluctuations in exchange taken into account

CONSUMPTION

Apparent consumption of refined primary lead in the United States, refinery stocks disregarded, 1920–1924, in short tons

	1920	1921	1922	1923	1924
Supply:					
Stock in bonded warehouse Jan. 1	234	1,322	347	----------	2,617
Imports of pigs, bars, and old	35,719	31,301	3,551	21,099	12,247
Production	529,657	448,589	532,662	618,322	690,493
	565,610	481,212	536,560	639,421	705,357
Withdrawn:					
Exports of foreign lead—					
From warehouse	17,363	25,000	32,355	48,736	76,758
In manufactures, with benefit of drawback	6,175	9,369	5,677	12,526	15,275
Exports of domestic lead	2,730	1,624	5,823	1,999	5,332
Stock in bonded warehouse Dec. 31	1,322	347	----------	2,617	5,045
	27,590	36,340	43,855	65,878	102,410
Apparent consumption	538,020	444,872	492,705	573,543	602,947

PRICES AND VALUE

The accompanying graph (fig. 5) shows the trend in the quoted price of lead for prompt delivery in the New York market in 1923–24. The price rose from 8.3 cents a pound at the beginning of the year to 9.87 cents the last of February, and then declined to 7 cents in June. A decided upward trend through the remainder of the year culminated in a quotation of 10.2 cents at the end of December. The average quoted price for the year was 8.3 cents, compared with 7.4 cents in 1923. A graph of the lead prices quoted in London is shown for comparison; in it fluctuations in exchange have been taken into account.

The following are prices quoted on lead throughout 1924 by the American Smelting & Refining Co., in cents a pound:

Jan.	2	7.75	Apr.	9	8.50	Oct.	20	8.25
	10	7.90		11	8.25		23	8.40
	18	8.00		24	8.00		25	8.50
Feb.	1	8.15	May	5	7.75		27	8.65
	7	8.25		7	7.50	Dec.	8	8.75
	14	8.40		15	7.25		10	8.90
	15	8.50		22	7.00		11	9.00
	21	8.70	July	23	7.25		15	9.25
	27	8.90		29	7.50		18	9.35
	28	9.00	Aug.	11	7.75		23	9.50
Apr.	3	8.75		15	8.00		26	9.60

The average selling price, based on total sales, was 8 cents a pound in 1924, compared with 7 cents in 1923. The value of the refined lead produced in the United States from domestic ores, based on the average selling price a pound, was $90,625,000 in 1924, compared with $76,138,000 in 1923.

GOLD, SILVER, COPPER, AND LEAD IN ARIZONA

(MINE REPORT)

By V. C. Heikes

PRODUCTION

The mines of Arizona produced in 1924 gold, silver, copper, and lead valued at $99,610,379. Compared with that of 1923 the value of the output decreased $4,690,821, or 4.5 per cent. The New Cornelia, Miami Copper, Calumet & Arizona, United Verde Extension, United Verde, United Eastern, Arizona Commercial, and Midland mining companies paid dividends amounting to $9,544,991. The Phelps Dodge Corporation, operating mines at Bisbee and Morenci, Ariz., and also in Mexico and New Mexico, paid $2,000,000, which is not included in the total given above.

Although the quantity of copper increased, its total value was less. This decrease in value formed the greater part of the decrease in the State total, though there were also decreases in gold and silver, and no zinc was reported. The average value in the ore and tailings decreased from $6.13 in 1923 to $5.03 in 1924, and the value in gold and silver decreased from 71 cents a ton to 47 cents.

Mine production of gold, silver, copper, and lead in Arizona in 1924

	Number of producers	Ore and tailings	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	275	19,820,505	$4,878,465	6,649,276	677,752,013	18,642,314	----------	$99,610,379
Increase or decrease from 1923	−66	+2,805,327	−1,242,656	−694,466	+58,823,411	+2,350,766	−519,103	−4,690,821

[a] Includes placer production.

ORE

Copper ore led in quantity the ores mined in Arizona in 1924; dry and siliceous gold ores and lead ore followed. The total values of the metals in the ores and tailings were as follows: Dry gold ore, $2,171,505; dry gold and silver ore, $177,700; dry silver ore, $308,500; copper ore, $94,575,415; lead ore, $2,308,920; and copper-lead ore, $65,182. In addition the placers produced gold and silver valued at $3,157. Thus the State total was $99,610,379.

Ore and metals produced in Arizona in 1924

Source	Number of producers	Ore and tailings		Gold		Silver	
		Short tons	*Per cent*	*Fine ounces*	*Per cent*	*Fine ounces*	*Per cent*
Dry gold ore	65	[a] 209,356	1.06	92,771.09	39.31	169,405	2.55
Dry gold and silver ore	7	8,291	.04	4,857.81	2.06	98,294	1.48
Dry silver ore	38	[b] 22,108	.11	3,001.16	1.27	342,514	5.15
Copper ore	67	[c] 19,460,836	98.18	128,121.07	54.29	5,101,837	76.73
Lead ore	109	114,670	.58	6,407.26	2.72	912,741	13.72
Copper-lead ore	6	5,244	.03	685.50	.29	24,458	.37
Total deep mines		19,820,505	100.00	235,843.89	99.94	6,649,249	100.00
Total placers	9			151.85	.06	27	
		19,820,505		235,995.74	100.00	6,649,276	100.00

Source	Copper		Lead	
	Pounds	*Per cent*	*Pounds*	*Per cent*
Dry gold ore	1,065,709	0.16	8,094	0.04
Dry gold and silver ore	86,898	.01	497	
Dry silver ore	116,348	.02	21,679	.12
Copper ore	675,638,828	99.69		
Lead ore	725,567	.10	18,373,553	98.56
Copper-lead ore	118,663	.02	238,491	1.28
	677,752,013	100.00	18,642,314	100.00

[a] Includes 49,947 tons of tailings.
[b] Includes 1,069 tons of tailings.
[c] Includes 1,100 tons of slag and 1,195,036 tons of ore leached.

GOLD ORE

Gold ore represented 1 per cent of the total output of ore and was mined by 65 producers in 1924, the same number as in 1923. This ore and tailings averaged $9.16 in gold and 0.81 ounce of silver to the ton, with a little copper, and had a value of $10.37 a ton. Mohave County, with 26 producers, reported the largest output of gold ore, followed by Yavapai County, with 19 producers, and Maricopa County, with 7 producers.

Dry gold ore and tailings sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	101	109.80	52		
Gila	20	14.61	7		
Maricopa	[a] 48,141	2,675.16	3,923		
Mohave	[b] 98,808	78,420.40	39,132	36	1,617
Pima	208	183.25	450		
Pinal	32	13.70	12	262	
Yavapai	[c] 61,985	11,299.39	125,750	1,065,388	6,477
Yuma	66	54.78	79	23	
	209,356	92,771.09	169,405	1,065,709	8,094

[a] Includes 48,000 tons of tailings.
[b] Includes 1,860 tons of tailings.
[c] Includes 87 tons of tailings.

GOLD AND SILVER ORE

Only four counties recorded a production of gold-silver ore. This ore averaged $12.11 in gold and 11.86 ounces of silver to the ton, carried a little copper and lead, and had a value of $21.43 a ton.

Dry gold and silver ore sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	8,193	4,830.00	97,466	85,753	----------
Mohave	10	6.25	169	----------	497
Santa Cruz	25	8.76	388	----------	----------
Yavapai	58	12.80	271	1,145	----------
	8,291	4,857.81	98,294	86,898	497

SILVER ORE

A total of 38 producers in 8 counties reported the output of silver ore. The largest quantity came from producers in Cochise County, mainly in the Turquoise and Tombstone districts. The silver ore and tailings averaged $2.81 in gold and 15.49 ounces of silver to the ton, with a little copper and lead, and was valued at $13.95 a ton.

Dry silver ore and tailings sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	[a]19,396	2,729.56	243,713	92,870	18,657
Gila	10	.31	1,389	103	----------
Graham	2	1.70	120	----------	----------
Mohave	132	43.85	16,442	807	2,943
Pinal	148	14.20	5,439	428	----------
Santa Cruz	545	8.80	15,433	3,758	----------
Yavapai	1,843	202.74	55,039	17,860	79
Yuma	32	----------	4,939	522	----------
	22,108	3,001.16	342,514	116,348	21,679

[a] Includes 1,069 tons of tailings sold to a smelter.

COPPER ORE

Of the copper ore mined by 67 producers in Arizona, 16,318,959 tons came from low-grade disseminated deposits worked by 6 companies, whose mines were near Globe, Ray, Ajo, Bisbee, Morenci, and Clifton. The richer siliceous ore, or that valuable as converter lining, was shipped to the smelters. The crude copper ore mined and smelted directly (without concentration) amounted to 2,557,223 tons. The total output of copper ore mined and treated in 1924 averaged 14 cents in gold and 0.26 ounce of silver to the ton and 1.74 per cent of copper, and was valued in all at $4.86 a ton, compared with $5.86 in 1923.

Copper ore sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Cochise	2,476,406	50,630.18	1,391,049	141,309,818
Gila	8,411,862	8,319.09	646,784	190,449,958
Graham	10	.50	78	2,901
Greenlee	[a]1,086,612	2,642.21	92,173	41,048,142
Maricopa	11	.20	----------	698
Mohave	31	----------	8	5,679
Pima	[b]3,008,893	10,687.48	197,612	67,261,855
Pinal	3,137,034	8,153.71	697,662	93,176,918
Santa Cruz	136	9.30	2,611	23,046
Yavapai	1,338,296	47,665.80	2,068,552	142,170,584
Yuma	1,545	12.60	5,308	189,229
	19,460,836	128,121.07	5,101,837	675,638,828

[a] Includes 1,100 tons of slag.
[b] Includes 1,195,036 tons of ore leached.

LEAD AND COPPER-LEAD ORE

Lead ore was mined in 11 counties by 109 producers, who reported an output that averaged $1.16 in gold and 7.96 ounces of silver to the ton, 8.01 per cent of lead, and a little copper, and was valued in all at $20.14 a ton. Most of the output of the 20 producers of lead ore in Cochise County came from mines near Bisbee, in the Warren district. In Mohave County 15 mines produced 25,671 tons of lead ore; most of this was mined in the Owens district. Twenty-five producers in Santa Cruz County reported 3,203 tons, 14 producers in Pima County reported 1,399 tons, and 8 producers in Gila County reported 1,130 tons.

Copper-lead ore (5,244 tons) was reported from mines in Mohave, Pima, Pinal, Santa Cruz, and Yavapai Counties.

Lead ore sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	82,022	5,759.93	648,837	632,716	14,553,867
Gila	1,130	54.80	4,614	8,648	368,580
Graham	115	----------	584	1,156	59,527
Greenlee	27	----------	77	421	10,036
Maricopa	11	1.90	111	262	8,196
Mohave	25,671	43.48	188,583	1,942	1,406,582
Pima	1,399	143.27	8,946	10,976	381,765
Pinal	540	73.30	2,313	4,138	235,374
Santa Cruz	3,203	299.19	49,796	63,988	1,104,187
Yavapai	347	29.77	4,868	1,052	46,249
Yuma	205	1.62	4,012	268	198,790
	114,670	6,407.26	912,741	725,567	18,373,553

Copper-lead ore sold or treated in Arizona in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Mohave	25	----------	2,600	2,170	5,078
Pima	58	28.10	1,735	6,744	34,188
Pinal	188	30.30	3,871	16,314	127,158
Santa Cruz	23	1.10	964	1,234	6,831
Yavapai	4,950	626.00	15,288	92,201	65,236
	5,244	685.50	24,458	118,663	238,491

The following table gives the lead-zinc ore produced in 1922 and 1923, also the average zinc content (assay) and recovered zinc:

Lead-zinc ore produced from Arizona mines, 1922–23 [a]

Year	Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore	Zinc recovered
			Short tons	*Pounds*	*Per cent*	*Pounds*
1922	Oxidized lead-zinc ore	Cochise	457	247,793	27.11	210,624
1923	do	do	1,313	610,709	23.26	519,103

[a] No zinc was produced in 1921 or 1924.

GOLD

Of the total gold output, 34.5 per cent was recovered from ore and tailings treated in gold and silver mills and 51 per cent was gold in crude ore shipped to smelters. Ores treated in mills by amalgamation yielded gold valued at $14,375, and ores and tailings treated by cyanidation $1,670,061. Concentrates contained gold valued at $703,403, against $362,871 in 1923, and ores shipped directly to smelters contained $2,486,542, against $2,797,144 in 1923. The chief gold-producing districts were the San Francisco district, Mohave County, which yielded siliceous gold ores, and the Verde district, Yavapai County, and Warren district, Cochise County, which produced copper ores.

Of the mines yielding gold, the United Verde Copper Co. reported the largest output; the United Eastern, at Oatman, was second. The Calumet & Arizona, at Bisbee, the Copper Queen, at Bisbee, and the Gold Road and the Tom Reed, at Oatman, were the next largest producers of gold.

SILVER

The largest increase in silver was recorded in Pinal County and the largest decrease in Yavapai County. Bullion from gold and silver ores and tailings contained 49,070 ounces of silver recovered by cyanidation and 482 ounces recovered by amalgamation. Concentrates contained 20 per cent of the total output of silver and crude ore shipped to smelters 79 per cent.

Of the total silver 67 per cent came from the ore of the United Verde, Copper Queen, Calumet & Arizona, Magma, and Shattuck-Arizona mines, each of which produced more than 350,000 ounces. The other mines yielding more than 140,000 ounces of silver each were the United Verde Extension, Superior & Boston, Bunker Hill, Signal, New Cornelia, and Old Dominion.

COPPER

According to the majority of producers, copper metal in 1924 sold at a price too low to bring a reasonable return. Although fluctuations in the selling price were not so marked as in 1923, the variations being but 2¾ cents a pound as against 5 cents that year, the average obtained was somewhat less. Copper was quoted at 12⅞ cents a pound in January; it advanced to 14 cents in March, but decreased throughout the summer, reaching 12¼ cents in July. In October the price improved, and at the end of the year was 15 cents.

Although the average price of copper was lower in 1924, the Arizona mine production of copper was 10 per cent greater than in 1923. Of the total copper produced in the State, 55 per cent was contained in concentrates, 41 per cent in shipping ore, and 4 per cent in ore leached. Of the output from crude ore smelted Yavapai County yielded 51 per cent and Cochise County 36 per cent. The copper from ore milled came mainly from Gila County. The low-grade disseminated ores in Cochise, Pima, Pinal, and Gila Counties yielded 321,458,562 pounds of copper, compared with 271,130,885 pounds in 1923. Similar low-grade copper deposits were worked in Greenlee County, so that the total production from the disseminated deposits in Arizona was 355,858,614 pounds. In 1923 these ores altogether produced 295,635,782 pounds of copper.

Nine properties, each yielding more than 38,000,000 pounds, produced 89 per cent of the total quantity of copper. The Copper Queen was first, followed by the United Verde, Inspiration, Ray Consolidated, New Cornelia, Miami, Phelps Dodge property at Morenci, United Verde Extension, and Calumet & Arizona.

LEAD AND ZINC

The largest yield of lead was in silver-lead ore produced at the Shattuck mine, at Bisbee, the Copper Queen mine, also at Bisbee, and the Hilltop Metal mine, at Hilltop, all in Cochise County. Mines in Mohave, Santa Cruz, and Pima Counties followed.

No zinc was produced in Arizona in 1924.

MINING INDUSTRY

A new smelter and two concentrators of 5,000 tons capacity were completed during the year and many important additions made to plants. The Magma Copper Co. is said to have spent $4,000,000 in building its smelter at Superior and the standard-gauge railroad from Superior to Magma Junction, on the Arizona Eastern branch of the Southern Pacific System. A brickmaking plant of the Magma Copper Co. supplied bricks for the smelter and for buildings in Superior. At the Inspiration mines the Porphyry shaft, 1,400 feet deep, was completed and the mine plant, which cost about $3,500,000, was put in operation November 25. At the same time ground was broken for a plant designed to use ferric sulphate and sulphuric acid for leaching copper ores carrying oxides and sulphides. In general the plant will consist of a crushing department, a leaching department, and an electrolytic refinery. At Douglas a complete new sampling plant and crushing plant was erected at the Calumet & Arizona smelter, and the smelter was equipped with Cottrell precipitators in 1924. The New Cornelia 5,000-ton flotation plant at Ajo was completed in April. A crushing plant costing approximately $1,000,000 was completed at the Clarkdale works to take the place of the Hopewell plant of the United Verde Copper Co., and a new shaft 1,476 feet deep was completed on the Verde Central property. In the Morenci district the Phelps Dodge Corporation remodeled its No. 6 concentrator for milling 5,000 tons of ore a day. At Hayden the Ray Consolidated remodeled its concentrator. The merging of the Ray property with the Chino mine, in New Mexico, was effected in 1924. At the Miami mine in the

Globe district the high-grade ore is said to be nearing exhaustion, and the company plans to enlarge its mill to treat 10,000 tons daily. It is believed that a profit will be obtained on ore averaging about 1 per cent of copper. The mill and smelter of the Southwest Metals Co. at Humboldt were closed in March, and the only work done thereafter was a concentration test made for the United Verde Copper Co.

Few changes in the wage scale were made during 1924. Much work was done on the contract or bonus basis, and numerous instances are reported of average earnings of $6.50 to $8 a day for a large proportion of the men on the pay roll. Lower costs were reported from several mines producing low-grade ores, and at concentration plants, particularly in the flotation departments, extraction was greatly improved as a result of better flow sheets and more careful and systematic work.

METALLURGIC INDUSTRY

There were 38 active milling plants in Arizona in 1924. Seventeen were concentration plants, of which 13 used tables and flotation devices and 3 used flotation alone. Nine mills were equipped for amalgamation, 7 for cyanidation, 4 for amalgamation and concentration, and 1 for leaching. The leaching of ore dumps was continued near Bisbee and Jerome, and at the Arizona-Bagdad property in Yavapai County leaching of ore "in place" was given a trial. Underground leaching of roasted pyrite "in place" was started at the Copper Belle mine, near Gleeson, in Cochise County Near Bisbee the Shattuck-Arizona Copper Co. was developing a hydrometallurgical process for lead ores. At Inspiration ground was broken for a plant to treat mixed oxidized and sulphide ores, and the New Cornelia Co., at Ajo, put its new 5,000-ton flotation plant in operation.

A marked decrease (43 per cent) was shown in the gold saved by cyanidation, due chiefly to the closing of the United Eastern mine, in Mohave County.

Gold and silver produced at mills in Arizona in 1924

County	Ore (short tons)	Bullion (fine ounces) recovered by—				Total value
		Amalgamation		Cyanidation		
		Gold	Silver	Gold	Silver	
Cochise	400			15.30	5,839	$4,228
Gila	20	14.61	7			307
Maricopa	140	79.37	19	[a] 2,592.47	[a] 3,904	57,861
Mohave	96,915	159.12	115	[b] 78,157.97	[b] 38,934	1,645,121
Pima	[c] 203	154.95	190			3,330
Santa Cruz	25			8.76	388	441
Yavapai	[d] 800	235.18	76	[e] 14.69	[e] 5	5,219
Yuma	65	52.18	75			1,129
	98,568	695.41	482	80,789.19	49,070	1,717,636

[a] Includes bullion from 48,000 tons of old tailings.
[b] Includes bullion from 1,860 tons of old tailings.
[c] Also yielded 1 ton of siliceous concentrate.
[d] Also yielded 2 tons of siliceous concentrate and 22 tons of lead concentrate.
[e] Bullion from 87 tons of old tailings.

Concentration reduced 15,738,134 tons of ore to 1,062,844 tons of concentrates, and gold and silver mills produced 25 tons of concentrates.

Mine production of metals from Arizona concentrates in 1924

By counties

County	Ore to concentrating mills	Concentrates produced	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Cochise	1,488,479	327,091	7,900.00	90,718	40,397,510	----------	$5,516,163
Gila	8,289,487	319,328	6,720.42	303,898	177,042,177	----------	23,535,060
Greenlee	1,041,573	85,474	2,284.25	74,970	34,400,052	----------	4,603,857
Mohave	25,326	1,202	29.52	183,990	1,893	1,085,176	210,945
Pima	1,789,826	61,115	10,703.78	162,327	39,407,932	----------	5,492,465
Pinal	3,071,121	264,500	5,631.59	468,414	80,998,757	----------	11,041,089
Yavapai	32,295	4,154	757.57	29,304	1,484,671	79,095	236,114
Yuma	27	5	----------	90	----------	4,624	430
	15,738,134	1,062,869	34,027.13	1,313,711	373,732,992	1,168,895	50,636,123

By kinds of concentrates

Dry and siliceous	15	34.50	3,203	92	----------	$2,871
Copper	1,061,484	33,644.24	1,119,664	373,727,904	----------	50,404,018
Lead	1,370	348.39	190,844	4,996	1,168,895	229,234

Average recoverable content

	Short tons	*Fineounces per ton*	*Fineounces per ton*	*Per cent*	*Per cent*	
Dry and siliceous	15	2.30	213.53	0.31	----------	$191.40
Copper	1,061,484	.03	1.05	17.60	----------	47.48
Lead	1,370	.25	139.30	.18	42.66	167.32
	1,062,869	.03	1.24	17.58	.05	47.64

Of the first-class material smelted the copper ore constituted the largest part. The Verde district, in Yavapai County, produced more than 50 per cent. The dry and siliceous ore came next, followed by lead ore.

Mine production of metals from Arizona crude ore shipped to smelters in 1924

By counties

County	Crude ore to smelters	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Cochise	1,096,175	56,125.17	2,281,659	101,179,952	14,572,524	$17,109,297
Gila	123,515	1,653.78	348,889	13,293,483	368,580	2,038,875
Graham	127	2.20	782	4,057	59,927	5,895
Greenlee	43,966	331.28	15,555	6,310,752	10,036	844,782
Maricopa	23	5.42	111	960	8,196	968
Mohave	576	167.38	23,895	8,741	331,541	47,138
Pima	25,488	183.37	46,226	3,395,282	415,953	512,819
Pinal	66,821	2,653.62	240,883	12,199,303	362,532	1,843,359
Santa Cruz	3,907	318.39	68,804	92,026	1,111,018	153,618
Yavapai	1,374,297	58,829.06	2,240,383	141,863,559	38,946	21,304,402
Yuma	1,756	16.82	14,173	190,042	194,166	50,273
	2,736,651	120,286.49	5,281,360	278,538,157	17,473,419	43,911,426

By kinds of ore

Dry and siliceous	90,051	19,070.11	554,426	1,268,245	22,892	$933,651
Copper	2,557,223	94,775.15	3,992,185	276,520,029	----------	40,858,064
Lead	89,083	6,381.73	725,579	723,421	17,277,272	2,095,010
Copper-lead	294	59.50	9,170	26,462	173,255	24,701

Mine production of metals from Arizona crude ore shipped to smelters in 1924—Continued

Average recoverable content

	Crude ore to smelters	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	
Dry and siliceous	90,051	0.212	6.16	0.70	0.01	$10.37
Copper:						
Oxidized	261,248	.028	2.01	6.94		20.11
Sulphide	2,295,975	.038	1.51	5.23		15.51
Lead:						
Oxidized	85,277	.073	8.11	.38	9.31	22.84
Sulphide	3,806	.043	8.95	.92	18.31	38.61
Copper-lead:						
Oxidized	33	.157	35.67	2.93	12.66	55.06
Sulphide	261	.208	30.62	4.70	31.59	87.68
	2,736,651	.044	1.93	5.09	.32	16.05

REVIEW BY COUNTIES

GENERAL FEATURES

Mine production of gold, silver, copper, and lead in Arizona in 1924

County	Gold					Silver •	
	Placers		Deep mines		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Cochise			64,059.48	$1,324,227	$1,324,227	2,381,117	$1,595,348
Gila			8,388.80	173,412	173,412	652,794	437,372
Graham			2.18	45	45	782	524
Greenlee			2,642.19	54,619	54,619	92,250	61,808
Maricopa	18.67	$386	2,677.27	55,344	55,730	4,035	2,703
Mohave			78,513.98	1,623,028	1,623,028	246,934	165,446
Pima	10.16	210	11,042.08	228,260	228,470	208,745	139,859
Pinal	15.34	317	8,285.23	171,271	171,588	709,301	475,232
Santa Cruz			327.16	6,763	6,763	69,192	46,359
Yavapai	107.68	2,226	59,836.54	1,236,931	1,239,157	2,269,788	1,520,758
Yuma			68.98	1,426	1,426	14,338	9,606
	151.85	3,139	235,843.89	4,875,326	4,878,465	6,649,276	4,455,015
Total, 1923	428.31	8,854	295,680.92	6,112,267	6,121,121	7,343,742	6,021,868

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Cochise	142,121,157	$18,617,872	14,572,524	$1,165,802	$22,703,249
Gila	190,458,709	24,950,091	368,580	29,486	25,590,361
Graham	4,057	531	59,927	4,794	5,894
Greenlee	41,048,563	5,377,362	10,036	803	5,494,592
Maricopa	960	126	8,196	656	59,215
Mohave	10,634	1,393	1,416,717	113,337	1,903,204
Pima	67,279,575	8,813,624	415,953	33,276	9,215,229
Pinal	93,198,060	12,208,946	362,532	29,003	12,884,769
Santa Cruz	92,026	12,055	1,111,018	88,882	154,059
Yavapai	143,348,230	18,778,618	118,041	9,443	21,547,976
Yuma	190,042	24,896	198,790	15,903	51,831
	677,752,013	88,785,514	18,642,314	1,491,385	99,610,379
Total, 1923	618,928,602	90,982,504	16,291,548	1,140,408	ᵇ104,301,200

• Includes placer production.
ᵇ Includes $35,299—the value of 519,103 pounds of zinc produced in 1923.

Ore sold or treated, number of deep mines producing, and average value of ore per ton in Arizona, 1923 and 1924

County	Ore and tailings sold or treated, 1924 (short tons)		Number of deep mines producing		Average total value per ton [a]		Average value per ton in gold and silver [a]	
	Total	Increase or decrease	1923	1924	1923	1924	1923	1924
Cochise	2,586,123	+801,982	50	40	$12.56	$8.78	$1.84	$1.13
Coconino		−56	1		34.80		1.14	
Gila	8,413,022	+395,224	27	23	3.77	3.04	.10	.07
Graham	127	+83	4	6	48.61	46.41	25.93	4.48
Greenlee	1,086,639	+428,843	12	4	6.68	5.06	.26	.11
Maricopa	48,163	+33,735	5	9	1.27	1.22	1.12	1.21
Mohave	124,677	−99,600	39	52	14.34	15.26	13.94	14.34
Pima	3,010,553	+1,159,194	37	28	3.47	3.06	.03	.12
Pinal	3,137,942	+353,931	37	21	3.75	4.11	.13	.21
Santa Cruz	3,932	−2,806	29	32	29.07	39.18	10.55	13.51
Yavapai	1,407,479	−186,789	62	37	16.30	15.31	2.67	1.96
Yuma	1,848	−78,414	14	14	12.32	28.05	.15	5.97
	19,820,505	+2,805,327	317	266	6.13	5.03	.71	.47

[a] Placer product excluded.

COCHISE COUNTY

The output of gold, copper, and lead from mines in Cochise County was larger in 1924 than in 1923. Silver production decreased, and no zinc was produced. There were 40 producers, 11 less than in 1923. The value of the output of silver decreased from $2,225,177 to $1,595,348; gold increased from $1,060,254 to $1,324,227; copper, from $18,410,010 to $18,617,872; and lead, from $679,792 to $1,165,802. Ore of smelting grade (1,096,175 tons) averaged $15.61 a ton. The total content of each metal is given in the table on page 173. Of the ore smelted 987,927 tons was classified as copper ore, of which 225,952 tons was estimated to be oxidized ore and 761,975 tons sulphide ore. All the lead ore with which some concentrate was mixed (82,022 tons) was shipped to plants outside the State; it contained 5,759.93 ounces of gold, 648,837 ounces of silver, 632,716 pounds of copper, and 14,553,867 pounds of lead. All but 606 tons of this ore was oxidized. Milling ore yielded 327,091 tons of copper concentrate, which was also shipped for smelting. There was no output from placers.

California district.—More than 4,000 tons of silver-lead ore from the property of the Hilltop Metal Mining Co. was hauled 24 miles to the railroad station at Rodeo, N. Mex., for shipment to El Paso, Tex. About 20,000 tons of oxidized ore, averaging 25 per cent of lead and 7 ounces of silver to the ton, is said to be developed in quartz veins and contact deposits. The mine is opened by three tunnels 2,000 to 4,000 feet long. The King of Lead claim was also a producer of lead ore that carried after sorting 53 per cent of lead and 56 ounces of silver to the ton.

Charleston district.—Several lots of ore and old tailings from the milling of ores of the Tombstone district in the early days were shipped for smelting. Lead ore was mined at the Arlington claim and the property of the Gallagher Vanadium Rare Metal Corporation.

Cochise district (*Johnson, Dragoon, Golden Rule*).—Five operators in the Cochise district produced copper ore and lead ore amounting to 1,116 tons; all this ore except 93 tons was shipped direct to smelters. The Arizona United Development Co. shipped several hundred tons of sulphide copper ore mined in the course of development work. The Golden Eagle mine, in the Golden Rule district, four miles east of Dragoon, produced lead ore containing gold and silver valued at about $18 a ton. Smelting charges on this ore were about $6 a ton and the freight was $1.90 a ton. The shipping point is Manzoro, on the Southern Pacific Railroad. From the Keystone or Bannon mine, at Johnson, a little ore was milled and one lot of copper concentrate shipped to El Paso, Tex. The Winchester property, 17 miles north of Johnson, produced about 200 tons of siliceous silver ore.

Dos Cabezas and Teviston districts.—Litigation retarded production from the Henry Clay property, formerly operated by the Gold Prince Mining & Milling Co. Lessees working the property from time to time shipped several lots of siliceous gold ore averaging about 1 ounce of gold to the ton. The stamp mill on the Henry Clay mine was idle. In September development work was resumed at the Dives mine in the lower crosscut tunnel, which will be about 1,500 feet long when completed and is expected to cut the Dives vein at a depth of 500 feet. At Mascot the Central Copper Co. acquired the properties of the Mascot Copper Co., the town site, and the Mascot & Western Railroad Co. The company owns about 1,380 acres, embracing 85 mining claims. Development work on the Consolidated Hill and Elma units in 1924 amounted to 5,425 feet, and 1,395 feet of diamond drilling was done.

Huachuca Mountain district.—Lead ore carrying a little silver was shipped to El Paso, Tex., from the Panama claims of the Manila mine, about 7 miles northwest of Fort Huachuca, in the foothills at the north end of the Huachuca Mountains. At the Manila mine a bedded deposit in limestone is opened by a vertical shaft 200 feet deep.

Swisshelm district (*Webb, Elfrida*).—Lead ore containing a little silver and gold was shipped to El Paso, Tex., from the Scheerer group of claims operated by the Colford Copper Co., 14 miles east of Elfrida. From the Four Horse and Apex mines considerable silver-lead ore, mostly carbonate, was hauled to Webb, a shipping point on the Southern Pacific Railroad, for shipment to El Paso. The mine is developed by three tunnels 400 to 660 feet long.

Tombstone district.—Nine producers in the Tombstone district reported the output of 15,448 tons of ore, containing $50,820 in gold, 247,642 ounces of silver, 72,836 pounds of copper, and 465,323 pounds of lead, valued in all at $263,508, or $17.06 a ton. The output includes 400 tons of siliceous silver ore containing a little gold; it was treated by cyanidation. At the property of the Bunker Hill Mines Co., the largest producer, 40 different sets of lessees worked continuously on more than 20 different claims throughout 1924. The production was 11,088 tons of silver ore shipped to Douglas and 1,828 tons of lead ore shipped to El Paso, Tex. Silver ore was shipped from the Argenta, Rocky Bar, Solstice, and Sunset properties. The cyanide mill of the Bonanza Leasing Co., which oper-

ates the Mellgren group of 56 lode claims, was active part of the year. The ore mined, part of which was shipped for smelting, averaged about $50 a ton in gold and silver. One lot of oxidized lead ore containing silver was shipped from the San Juan property, 12 miles northeast of Tombstone, in Horstman Basin. In the course of development considerable ore carrying zinc sulphide is said to have been opened. The adjoining Zinc Basin claim produced several small lots of silver-lead-zinc ore that averaged about $20 a ton for the lead and silver. In June the Grand Central Mining Co. started to treat old tailing near Fairbank, often previously tried by others, first by cyanidation, then volatilization. Success was attained by flotation. Sodium sulphide was used as a sulphidizing agent, and the water was heated to about 165° F. About 130 tons of the tailing, containing 80 cents in gold and 3 ounces of silver a ton and 4.5 per cent of lead, was treated daily. The recovery reported was 65 per cent of the silver and about 90 per cent of the lead, making a product containing $6 in gold and 18 ounces of silver a ton and 45 per cent of lead.

Turquoise district (*Courtland*, *Pearce*, *Gleeson*).—Nine mine operators in the Turquoise district reported a total output of 16,751 tons of ore, containing $31,320 in gold, 83,797 ounces of silver, 1,329,543 pounds of copper, and 635,643 pounds of lead, valued in all at $312,485, or $18.65 a ton. Lessees operating the Germania and Maid of Sunshine properties shipped considerable oxidized copper ore from Courtland, on the Southern Pacific Railroad. The Thelma, Great Western, and Leadville (Copper Rug) properties also made important shipments of copper ore from this station. From Gleeson silver-lead ore was shipped from the Mystery and the Silver Bill properties, and silver ore from the Tejon mine. The Mystery is a prospect, and ore was first discovered there in August. The Commonwealth mine shipped considerable crude ore and tailings containing silver and a little gold. At the Copper Belle mine, near Gleeson, the experimental leaching of copper ore "in place" by first setting fire to sulphide ore and then circulating solutions stored or dammed in the 400-foot level began in June. If the experiment is not successful it is reported that mining can be resumed on the 450-foot sublevel and the 500-foot level.

Warren district (*Bisbee*, *Lowell*, *Warren*, *Don Luis*).—Four-fifths of the total ore mined in 1924 in the Warren district was from the Copper Queen property, which greatly increased its production of milling ore from Sacramento Hill by use of steam shovels. Six producers reported 1,059,350 short tons directly smelted, the two copper smelters at Douglas taking most of it. Lead ore was shipped to El Paso, Tex., but no zinc ore was marketed. Altogether the Warren district produced 2,547,736 tons of ore, containing $1,235,494 in gold, 2,011,662 ounces of silver, 140,629,972 pounds of copper, and 11,438,397 pounds of lead, valued in all at $21,920,906, or $8.60 a ton.

The Copper Queen branch of the Phelps Dodge Corporation, at Bisbee, increased its metal output decidedly in 1924 as a result of mining at Sacramento Hill. Underground production on company account increased slightly, but the output by lessees was much less. In the Don Luis Basin lessees continued work on a small scale. At Sacramento Hill 2,319,529 solid yards of ore and waste were removed

by steam shovel, of which 1,637,650 yards went to the leach and waste dumps, 675,120 tons, averaging 0.88 per cent of copper, went to the No. 1 leach dump, and 78,960 tons, averaging 0.69 per cent of copper, to the No. 2. The mill at Warren received 1,455,474 tons, the stock pile 35,696 tons, and the smelter 24,039 tons. The concentrator, recently described in detail,[1] treated 1,488,386 tons of ore, averaging 1.59 per cent of copper, which yielded 329,244 tons of concentrate assaying 6.48 per cent of copper. The ratio of concentration was 4.49 to 1. The tailing assayed 0.19 per cent copper, of which 0.13 per cent was in the form of sulphide. Considerable experimenting was done at the concentrator to eliminate pyrite from the concentrate. This work was partly successful, and toward the end of 1924 a ratio of concentration of 6 to 1 was obtained. The annual report of the Copper Queen branch of the Phelps Dodge Corporation showed production as follows:

Ore and metals contained in output of Copper Queen mines, 1924

Kind of material	Total (dry weight)	Gold	Silver	Copper	Lead
Underground:					
Company—	*Short tons*	*Ounces*	*Ounces*	*Pounds*	*Pounds*
Copper ore	393,266	6,924	248,376	50,201,937	
Silver ore to Douglas	483	45	5,438	1,943	
Lease—Copper ore	83,582	11,201	228,103	8,267,570	
Company—Lead ore	9,168	659	124,292	30,867	1,674,738
Lease—Lead ore	19,803	500	73,643	568,916	4,419,875
Sacramento Hill:					
Company—					
Smelting ore	24,040	18	5,465	2,209,894	
Milling ore	1,491,170	10,503	221,180	47,264,030	
Precipitates:					
From leach heap	134		2	198,612	
From underground	550		22	373,249	
	2,022,196	29,850	906,521	109,117,018	6,094,613

The Calumet & Arizona property[2] produced 467,334 dry tons of ore from its Junction and No. 3 shafts. Of the ore mined 443,825 wet tons, containing 4.83 per cent of copper, were shipped for treatment at the company's smelter at Douglas, and 17,114 wet tons of ore low in copper and high in sulphur were sold to the Old Dominion smelter at Globe and the Copper Queen smelter at Douglas. Shipments of similar ore amounting to 17,242 tons and 782 tons of silver-lead ore were sold to the smelter at El Paso, Tex. In addition to the company ore, amounting to 410,805 tons, the smelter at Douglas treated 55,692 tons of New Cornelia (Ajo) concentrate and 126,827 tons of custom ore. During 1924 an average of 1,621 tons of dry ore and concentrates was smelted daily at Douglas, and the total output of blister copper was 79,025,610 pounds, as compared with 47,198,450 pounds in 1923. The large increase was due to New Cornelia concentrate, which the smelter began to receive in January. At Lowell the most important development underground was that made possible by the completion of the pump station on the 2,200-foot level. On this level, in the western part of the Erie cattle

[1] Wittenau, Ernest, The new Copper Queen concentrator: Eng. and Min. Jour. Press vol. 117, May 24, 1924, p. 836.
[2] Calumet & Arizona Mining Co. Ann. Rept. for 1924.

claim, about 600 feet from the Junction shaft, a large mineralized area containing high-grade ore and pyrite was cut. It was developed north and south for 135 feet and east and west for 42 feet, but its full extent is not known. Good ore was also developed near the Campbell shaft on the 1,800-foot level for a length of 140 feet; it is 1,500 feet south of any ore previously found in the Junction mine. Dividends amounting to $1,285,063 were distributed to stockholders.

The Shattuck mine[3] was operated continuously and produced 22,072 wet tons of oxidized copper ore and siliceous silver ore of smelting grade, from which was recovered 2,630,185 pounds of copper, 72,671 ounces of silver, and 754 ounces of gold. The output of carbonate lead ore, 42,611 wet tons, contained 5,244,526 pounds of lead, 315,776 ounces of silver, and 3,518 ounces of gold. The gross operating cost for copper was 12.621 cents a pound and for lead 12.13 cents; the net operating costs were 10.057 cents and 6.76 cents, respectively. The average price for copper sold was 14.273 cents a pound, and lead 7.973 cents. During 1924 there was 4,958 feet of exploration and development work done, at an average cost of $10.64 a foot, or 1 foot of development for each 4.12 tons of copper ore mined. The Wolverine & Arizona Mining Co. produced several thousand tons of good copper ore from a lease on property of the Calumet & Arizona Mining Co.

Work at the White Tail Deer, Night Hawk, and Crescent leases in the Don Luis section of the district continued during 1924, and considerable copper ore was shipped to the smelter at Douglas.

COCONINO COUNTY

Mining in Coconino County was at a standstill in 1924. The lead-vanadium ore, containing a little zinc, found in Cataract Canyon, 40 miles from Grand Canyon, still awaits a successful process of treatment. In the Warm Springs district, on the Kaibab Plateau, the Petoskey and the Buckskin Mountain copper properties were idle.

GILA COUNTY

There were 23 producers in Gila County, 4 less than in 1923, but the output of ore increased from 8,017,798 to 8,413,022 tons. Gold decreased from $193,628 to $173,412, silver from 708,691 to 652,794 fine ounces, copper from 198,531,893 to 190,458,709 pounds, and lead from 3,488,896 to 368,580 pounds. The county led all others in the value of its output, though the total decreased from $30,203,166 to $25,590,361. Copper ore was treated at Globe and Miami, but the lead ores and part of the copper ores were shipped to smelting plants outside the county. Of the copper ore smelted, 99,854 tons were sulphide and 22,521 tons were oxidized. The 123,515 tons of smelting ore shipped had an average value of $16.51 a ton, and the 319,328 tons of concentrates, all copper, had an average value of $73.70 a ton.

Banner district.—Several lots of sulphide lead ore and one lot of silver ore were shipped from the Banner district in 1924. The Seventy-nine mine, the chief producer in the past, was not worked

[3] Shattuck Arizona Copper Co. Ann. Rept. for 1924.

on company account, but a lessee is reported to have shipped a little lead ore.

Globe district (Miami).—Nineteen mine operators in the Globe district reported the production of 8,412,183 tons of ore, containing $172,219 in gold, 650,139 ounces of silver, 190,451,888 pounds of copper, and 88,366 pounds of lead, valued in all at $25,564,078, or $3.04 a ton. Most of the ore was concentrated, and yielded 319,328 tons of copper concentrate, which, with 122,696 tons of crude ore, was directly smelted. Most of the concentrate and first-class ore went to smelting plants in the district, but part of it was shipped to El Paso, Tex. The Inspiration group of mines made the largest output of copper ore, 5,487,939 tons. The next largest producer was the Miami, with 2,444,079 tons. Ore from both these mines was concentrated and the concentrate was treated at the International smelter at Miami. Other properties yielding copper ore were the Arizona Commercial, Iron Cap, Old Dominion, Gibson Consolidated, and Superior & Boston.

At the Inspiration property [4] work continued without interruption and the average monthly output was 7,559,156 pounds of copper. The average assay of the ore milled was 1.135 per cent of copper (oxide copper in mill feed 0.243 per cent); this value was lower than that anticipated, largely because of the delay in completing the new Porphyry shaft, through which the ore from the Live Oak section is hoisted. The shaft and its surface equipment were put in operation November 25. The production in 1924 was 90,709,878 pounds of copper, which was obtained from the treatment of 5,487,939 tons of ore, including 5,135,856 tons of Inspiration concentrating ore, 327,503 tons of Live Oak concentrating ore, 14,070 tons of Inspiration ore of smelting grade, 906 tons of Live Oak ore of smelting grade, and 9,604 tons of Warrior ore. The company's report also shows 123,049 pounds of copper was produced from ore treated in the experimental leaching plant in 1923, returnable in 1924. The average grade of the ore from the Inspiration section was 1.129 per cent copper; Warrior, 5.766 per cent; and Live Oak, 1.213 per cent. The smelter assay of the concentrate produced was 27.565 per cent copper; flotation concentrate, 32.55 per cent; and the table concentrate, 10.40 per cent. The ratio of concentration was 32.6 to 1. The recovery of copper in milling, calculated from assays and weights of ore and tailing, was 73.86 per cent. The recovery of copper sulphide in ore was 92.62 per cent. The cost of fine copper produced, including depreciation but excluding depletion and Federal taxes, amounted to 11.025 cents a pound. No dividends were paid to stockholders in 1924. The company's report says:

> During the past six years much experimental work has been done on processes for the treatment of mixed oxide and sulphide copper ores, resulting in a process that in a pilot unit operation from January 15 to December 15, 1923, gave satisfactory and consistent results. This process is known as the ferric sulphate process, using ferric sulphate and sulphuric acid as a solvent for the copper in oxide and sulphide form. In general it will consist of a crushing plant, leaching plant, and an electrolytic refinery.

[4] Inspiration Consolidated Copper Co. Ann. Rept. for 1924.

The Miami property[5] produced 2,444,079 tons of ore, all of which was milled. The total output of refined copper from this ore was 60,475,547 pounds, an average monthly production of 5,039,628 pounds. The annual report of the company says:

The entire tonnage stoped was produced by the undercut caving method of mining, and mining costs were lowered approximately 10 cents per ton, with a slightly higher cost per pound of copper due to a lower copper content. Part of the reduction in mining cost per ton was due to a lower average wage for 1924 of $5.15 per shift as compared with $5.426 in 1923. * * *

Ore milled, 2,444,079 tons, at 1.624 per cent copper.

Concentrate produced, 80,516 tons, at 39.532 per cent copper.

Copper in concentrate, 63,658,471 pounds.

Copper per ton ore, 26.046 pounds.

Mill extraction, 80.17 per cent.

The cost of milling ore to the point of concentrate on board cars is as follows:

Direct crushing expense	$0.32827
Direct concentrating expense	.21513
Tailing and concentrate handling	.04021
Water for concentrating	.04412
Miscellaneous expense	.00906

The total milling cost increased approximately 1½ cents per ton of ore as compared with the previous year. This is the result of a combination of causes, including increased power cost due to advance in the price of California fuel oil, increased maintenance labor and supply cost, and decrease in the cost of operating labor and supplies.

Remodeling of sections 4, 5, and 6 at the mill resulted in increased tonnage and considerably finer grinding, which latter had the effect of decreasing the tailings loss of sulphide copper. In spite of this reduced sulphide loss in the tailings, the mill extraction was lower than for the previous year, due to higher content of nonsulphide copper in the ore, which is not amenable to flotation.

The cost of producing refined copper up to concentrate on board cars at Miami was as follows:

	Per ton ore	Per pound copper
Mining	$1.12948	$0.04565
Milling	.63679	.02573
General	.27027	.01092
	2.03654	.08230

Exploration work has been carried on throughout 1924 in the territory east of the Miami fault, but no body of merchantable ore large enough to warrant exploitation has been found.

On January 1, 1925, the ore reserves stand as follows: High-grade sulphide ore, 4,034,505 tons at 2.08 per cent copper; mixed sulphide and oxide ore, 6,000,000 tons at 2 per cent copper; low-grade sulphide ore, 36,000,000 tons at 1.06 per cent copper.

Some of the tonnage of high-grade sulphide ore listed above is associated with the mixed sulphide and oxide ore and some of it is associated with the low-grade sulphide ore in such a manner that it would be more economical to mine it with these ore bodies. Also, about 1,500,000 tons of it lies below the present haulage levels and its mining at the present time at this deeper level would be a menace to the workings required for the mining of the low-grade ore body. As a result of these conditions there remains immediately available for mining slightly less than 1,500,000 tons of high-grade sulphide ore, so it will become necessary to begin mining from the low-grade ore body about next June, and the proportion of ore produced from this ore body will be gradually

[5] Miami Copper Co. Ann. Rept. for 1924.

increased until by the end of the year the entire output will be from the low-grade ore body. In order to make this an economical proposition the plant is being enlarged from a capacity of 6,800 tons daily to 10,000 tons daily, to be completed by July, 1925, and appropriate changes in operating details to handle this low-grade ore are being made. With this increased tonnage of lower grade ore an annual production of not less than 50,000,000 pounds of copper is estimated at a cost of not to exceed 8.4 cents per pound in the form of a 30 per cent or higher concentrate.

The Superior & Boston mine[6] during the fiscal year ended September 30, 1924, produced 21,304 dry tons of ore averaging 3.66 per per cent of copper and 13.95 ounces of silver to the ton. This ore contained 1,560,599 pounds of copper and 297,066 ounces of silver, for which the company received $217,539 after deducting freight and smelting charges, or an average of $10.21 a ton. Of the total output 71 per cent was produced from the Dewey veins, 28 per cent from the Rigby vein, and 1 per cent from the Footwall vein. Because of its higher content of silver and iron the ore was diverted from the International smelter at Miami to the El Paso smelter, in order to take advantage of a lower smelting charge and a reduced freight rate for the low-grade ore. The North and Dewey veins were explored east of the Mescal fault, and drifting to the east on the North vein at the 600-foot level will prospect both veins east of the fault. The quantity of water pumped from the mine decreased from 90,000 gallons a day in 1923 to 60,000 gallons.

The Old Dominion property[7] produced 294,999 tons of ore, of which 55,126 tons was smelting grade averaging 8.05 per cent of copper, 236,536 tons was concentrating ore averaging 3.81 per cent, and 3,337 tons was siliceous ore, used for converter lining, averaging 2.95 per cent. The total metal produced from the company ore and concentrate and the furnace material smelted was 26,098,168 pounds of copper, 140,453 ounces of silver, and 4,861 ounces of gold. The company contracted with the International smelter to treat its copper concentrate and other material, and the Old Dominion smelter was permanently closed November 30. The capacity of the concentrator at Globe was increased by minor changes from 1,000 to 1,300 tons of ore daily. The refined copper sold, including that from custom ores, amounted to 28,151,261 pounds, which was sold at an average price of 13.288 cents a pound. The following paragraphs are from the company's report:

> Developments for the year were, on the whole, decidedly encouraging, as there was an increase of 125,894 tons in ore reserves of all classes; also ore of commercial grade was discovered in a number of places where development was not sufficiently complete to justify its being taken in under the ore reserves. On the twentieth level five different streaks and bunches of ore were passed through by the drifts and crosscuts, one of which averaged 3.7 per cent copper for a distance of 20 feet, and another one averaged 2.7 per cent for 50 feet. The drift on the 2,200-foot level went through about 500 feet of ground, and there were five separate ore bodies of especial interest, four of which showed ore of better than 3.5 per cent grade. These occurrences open up possibilities for the undeveloped portion of the twentieth level west. * * *
>
> While formerly a large proportion of the product and also a large proportion of the earnings was made from handling oxidized ores, the reverse is now true and very little oxidized ore is being mined and at a very small profit, whereas the sulphide concentrating ores, which formerly yielded a very small

[6] Superior & Boston Copper Co. Ann. Rept. for year ended Sept. 30, 1924.
[7] Old Dominion Co. Ann. Rept. for 1924.

profit, are now the dependence of the mine. The indications are, however, that large bodies of oxidized ore will be encountered in the westerly part of the mine as development proceeds. * * *

A total of 1,538.9 million gallons of water was pumped from the mine during the year, or a daily average of 4.216 million gallons.

The Arizona Commercial Co.[8] shipped ore of milling grade from its Copper Hill mine to the Old Dominion concentrator and shipped concentrates and crude ore to the International smelter. Work stopped at the Eureka mine in June after a fire had partly destroyed the shaft. The output amounted to 70,236 tons of ore of milling grade averaging 5.68 per cent of copper and 6,691 tons of siliceous ore averaging 5.98 per cent. The total production was 7,760,931 pounds of refined copper, 32,634 ounces of silver, and 1,883.15 ounces of gold, which sold for $1,174,117.12. Expenses amounted to $891,127.07, leaving an income before depletion of $290,413.64. The total dividends paid since October 10, 1916, amounted to $1,484,000, including $265,000 paid in 1924.

The Iron Cap mine[9] and mill were operated continuously, and from 83,312 dry tons of ore mined 76,340 tons were milled, producing 11,086 tons of concentrate. The concentrate contained 4,934,904 pounds of copper, 61,525 ounces of silver, and 257.20 ounces of gold. From 6,944 tons of ore of smelting grade 755,256 pounds of copper, 33,706 ounces of silver, and a little gold was reported. Gravity concentration followed by flotation is used in the 350-ton mill, and the cost of milling was $1.60 a dry ton. Both the concentrate and the crude ore were sold to the International smelter. The receipts from the sale of copper were $704,735.96; silver, $57,621.88; gold, $2,810.02; and from other income, $20,902.20; or a total of $786,070.06. Transportation, refining, marketing, mining, and milling charges amounted to $684,872.71, which, with taxes, interest, discount on bonds, and administrative and litigation expense, totaled $776,405.01. Deduction of this amount from the total income left a profit of $9,665.05 before depreciation and depletion were calculated. The company's report contained the following paragraphs:

> The company has been unwilling to undertake an extensive program of exploration for new ore bodies. The cost of the necessary work is very large, and, in our opinion, the future for copper metal has been so uncertain that, in order for such a program to be successful, larger ore bodies would have to be found to repay that cost. The main Iron Cap vein has been carefully developed to the lateral limits of the ore as far as has been learned; the upward limits of extension of ore are well defined. The values decline with depth, and the lowest level opened—the 1,400—has shown a quantity and grade of ore from which the profit will not have paid the cost of its development. Geological conditions at that depth are such that we are not led to believe that profitable ore will be found by an extension downward of the shaft of only a few hundred feet.
>
> The Williams vein is yielding a moderate tonnage of excellent ore.

From the New Dominion property, 2 miles north of Globe, two cars of ore assaying 12 ounces of silver, $2.25 in gold, and 26 per cent of lead were shipped to the El Paso smelter. The Kearsarge and Monadnock claims, owned by the Lecora Mining Co., were worked by lessees, who shipped ore containing 1.74 per cent of copper and a little silver and gold. The Wall Street claim, 3 miles east

[8] Arizona Commercial Mining Co. Ann. Rept. for 1924.
[9] Iron Cap Copper Co. Twelfth Ann. Rept. for 1924.

of Miami, produced one car of copper ore. The ore from the Irene mine of the Globe Mining Co., which was shipped to El Paso, Tex., contained 4.6 ounces of silver to the ton, 6.7 per cent of lead, and 12.5 per cent of zinc, but no pay was received for the zinc. The Irene mine is opened by a shaft 210 feet deep and 300 feet of drifts. Lead ore was mined at Radium from the Old Stephens shaft, and similar ore from the Winner claim was shipped to El Paso. High-grade silver ore is shipped annually from claims in Richmond Basin, 14 miles north of Globe. Unusually rich ore was shipped from the Silver Lake mine, several tons averaging 148 ounces of silver and one small lot of closely sorted ore assaying 6,232 ounces to the ton.

Green Valley district.—At the Occidental mine a little bullion was marketed from the treatment of 20 tons of gold ore in a 10-ton Gibson mill, which is equipped for amalgamation and concentration. The mine is opened by a vertical shaft 200 feet deep.

GRAHAM COUNTY

Aravaipa district.—Four producers in the Aravaipa district reported the output of 115 tons of ore, containing 584 ounces of silver, 1,156 pounds of copper, and 59,927 pounds of lead, valued in all at $5,336. Most of the ore carries galena, which occurs in a siliceous gangue. The chief producers were the Ten Strike and Norton properties. Klondyke is the nearest supply point, but mines are accessible from Willcox on the main line of the Southern Pacific Railroad, a distance of about 60 miles by wagon road, or from Glenbar on the Arizona Eastern Railroad, a distance of 36 miles. The geology of the district is fully described in a recent bulletin[10] of the United States Geological Survey.

Rattlesnake district.—Ore carrying 61 ounces of silver and 0.87 to 1 ounce of gold to the ton was shipped to El Paso, Tex., from the Long Tom No. 2 claim, about 25 miles southeast of Klondike. On this claim is an inclined shaft about 45 feet deep recently opened.

Stanley Butte district.—A small lot of oxidized ore, containing 15.43 per cent of copper and 8 ounces of silver to the ton, was shipped to the smelter at Hayden from the Apache prospect, about 25 miles east of Christmas.

GREENLEE COUNTY

Except copper, all the metals produced in Greenlee County by four producers showed decreases in 1924—gold from $55,577 to $54,619, silver from 142,367 to 92,250 fine ounces, and lead from 11,875 to 10,036 pounds. The ore increased from 657,796 to 1,086,639 tons, the copper from 28,735,505 to 41,048,563 pounds, and the total value from $4,397,268 to $5,494,592.

Copper Mountain and Greenlee districts (Morenci, Metcalf, Clifton).—With the exception of the output of the Mayflower district, the figures given for Greenlee County represent the production from the Copper Mountain and Greenlee districts. Forty-eight tons of ore mined by two producers were reported from the Copper Mountain district and 1,086,571 tons were mined by the Phelps Dodge Cor-

[10] Ross, C. P., Aravaipa and Stanley Butte mining districts, Ariz.: U. S. Geol. Survey Bull. 763, pp. 76–105, 1925.

poration from the Greenlee district. At the end of 1924 the Morenci branch of the corporation had almost attained the rated capacity of its remodeled concentrator. After many metallurgical improvements, the cost of producing copper was decidedly lowered. The Morenci branch[11] of the Phelps Dodge Corporation produced 1,089,338 dry tons of ore (including 20,360 tons of lease ore and 1,248 tons of miscellaneous ore), which contained 54,241,671 pounds of copper. The No. 6 concentrator, at Morenci, treated 1,041,573 dry tons of ore averaging 2.27 per cent of copper, which yielded 87,085 tons of concentrate carrying 36,198,864 pounds of copper. The smelting plant handled both concentrate and crude ore, and produced blister copper containing 41,080,484 pounds of copper, 84,034 ounces of silver, and 2,759 ounces of gold. The average production of the smelter was 3,423,374 pounds of copper per month. All ores, except small lots from lessees, were produced from the Humboldt, Petaluma, and Clay mines.

Mayflower district.—The Wampum claim, 25 miles northeast of Duncan, produced two lots of sulphide ore. The lead ore averaged about 6 ounces of silver to the ton, 14.6 per cent of lead, and 1.92 per cent of copper, and the copper ore averaged 15.4 ounces of silver to the ton and 6.22 per cent of copper.

MARICOPA COUNTY

Gold and silver mills in Maricopa County treated 48,000 tons of old tailing and 140 tons of ore, which produced gold and silver bullion valued at $57,861. Ore shipped directly to the smelter, amounting to 23 tons, was valued at $42.09 a ton. A little placer bullion was reported by one operator.

Big Horn district.—A six-stamp amalgamation mill for a short time treated ore from the Discovery claim of the Pacific Slope Gold Mines Corporation. The property is 80 miles west of Phoenix, on the west slope of Yellow Medicine butte.

Cave Creek district.—Operators in the Cave Creek district treated small lots of free gold ore in hand mortars and sold the resulting gold bullion to merchants or banks at Phoenix.

San Domingo district.—Several lots of placer gold were purchased from small operations in the San Domingo district and shipped through storekeepers to the mint at San Francisco.

Superstition Mountain district.—The North Star claim was worked by lessees, who treated a little gold ore by amalgamation.

Vulture district.—At the Vulture mine part of the large tailing dump left from former operation of the amalgamation mill was retreated by cyanidation. As a result of this work the Vulture Milling Co. produced considerable gold, but reported a loss on the year's operations.

MOHAVE COUNTY

In Mohave County 52 producers, 12 more than in 1923, mined 124,677 tons of ore, a decrease of 99,600 tons. The gold declined from $2,808,342 to $1,623,028, the silver from 388,024 to 246,934 fine ounces, and the copper from 32,397 to 10,634 pounds. Lead in-

[11] Phelps Dodge Corporation Ann. Rept. for 1924.

creased slightly, from 1,205,425 to 1,416,717 pounds, but the total value decreased from $3,215,664 to $1,903,204.

The ore treated by amalgamation or cyanidation, mainly the latter, amounted to 96,915 tons, which, with 1,860 tons of old tailings, yielded $1,618,958 in gold and 39,049 ounces of silver, having a total value of $1,645,121, or an average of $16.66 a ton of ore and tailings. The concentrating ores (25,326 tons) yielded 1,202 tons of concentrates, against 1,696 tons of concentrates from 36,878 tons of ore in 1923. The concentrates in 1924 had a total value in metals of $210,945, or an average of $175.50 a ton. Crude ore shipped to smelters amounted to 576 tons, against 556 tons in 1923, and had a total value in metals of $47,138, or an average of $81.84 a ton.

Prospectors and small mine operators benefited considerably by the establishment of a sampling works at Kingman in 1924. The plant was constructed and operated by the Western Ore Purchasing Co., which from October to the end of the year purchased and shipped considerable ore from several northern counties.

Cedar Valley district.—Most of the ore produced in the Cedar Valley district yielded bullion after being treated by amalgamation, but a little lead ore was sold to the sampler at Kingman. The Diamond Joe and Dutch Flat properties were the chief producers.

Chemehuevis district.—Small lots of lead ore and gold ore were shipped to the sampler at Kingman from three properties. Oxidized ore from the Elise V. property was treated in a three-stamp amalgamation mill and gold bullion was shipped to the mint at San Francisco.

Greenwood district.—At the Bland property one small lot of bullion was recovered from sorted gold ore and shipped to the mint at San Francisco.

Hackberry district.—Gold ore containing a little lead and gold bullion recovered from ore treated by amalgamation comprised the total production of the district.

Indian Secret district (*White Hills*).—Development work on the White Hills group opened a new ore shoot in the drift from the 400-foot level of the Norma claim, and the crosscut was continued to the parallel vein. The mines have been shut down for a year or more on account of financial troubles. Lessees hauled several small lots of silver ore containing a little lead, copper, and gold 30 miles to Chloride on the Santa Fe System, whence it was shipped to a lead smelter.

Maynard district.—From prospects in the district small lots of lead ore were shipped to the ore sampler at Kingman.

Owens district.—Considerable development work was reported in the mines of the Owens district. The Signal Mines Co., working the McCracken property, treated the largest quantity of ore and produced lead-silver concentrate at its concentration-flotation plant. From the Otsego mine about 100 tons of lead ore containing a little silver was shipped. The Red Top claim, which is under development, also produced a little first-class lead ore.

San Francisco district (Oatman, Gold Road, Vivian).—Fourteen producers in the San Francisco district reported the mining and milling of 96,776 tons of ore, the shipment of 7 tons of high-grade ore to smelters, and the retreatment by cyanidation of 1,850

tons of old tailings. Most of the output was from the properties of three companies, the United Eastern, Gold Road, and Tom Reed, each producing almost equal quantities of milling ore. The total output of the district contained $1,617,196 in gold and 39,097 ounces of silver, valued together at $1,643,391, or $16.66 a ton of ore and tailings.

The Tom Reed, United Eastern, and Gold Road companies discontinued mining in May, June, and October, respectively. Lessees and prospectors who found the working of these and other mines in the district profitable used the Tom Reed mill as a custom plant. The United Eastern Mining Co. produced about 35,000 tons of ore from operations at Oatman and paid its last dividend of $408,900, which makes a total of $5,997,200 to the end of 1924.

The Gold Road Co.[12] mined and milled 29,856 tons of ore, including a clean-up of the mill. About 22,000 tons of ore and tailings from the Tom Reed property was treated in the Tom Reed mill, in addition to about 2,500 tons of custom ore and tailing. The Telluride Mining, Milling & Development Co. completed its 50-ton cyanide mill in February, and was continuously active the remainder of the year. The mill is similar in design to other mills in the district that have so successfully treated Oatman ores. The United American property produced more than 1,500 tons of gold ore, which was treated in the Tom Reed mill. About 3 tons of silver ore containing gold was hauled 20 miles to the Kingman sampling works from the Overlook and Red Crown claims. A little gold ore was treated at the Tom Reed mill for the Gold Dust Mines (Inc.). Considerable development work was done at the Oatman United mine, and a 75-ton cyanidation plant was under construction. In December the Katherine Gold Mining Co. put in the foundation for a 75-ton cyanidation mill, and at the Sheep Trail mine a Gibson mill handled ore from the Minnie Moore tunnel. The Orphan property, in the Secret Pass section, was credited with a small production of gold bullion.

Wallapai district (*Cerbat*, *Chloride*, *Kingman*, *Mineral Park*, *Stockton Hill*).—Seventeen producers in the Wallapai district reported the output of 388 tons of ore, of which 293 tons were shipped to the sampler at Kingman and 95 tons were treated at gold and silver milling plants. First-class ore smelted contained 92.19 ounces of gold, 4,954 ounces of silver, 6,460 pounds of copper, and 172,088 pounds of lead. The ore came from the Overlook, Kay, Horseshoe, Hibernia, Monitor, St. Louis, Panama, and from various old mine dumps, and consisted of small lots hauled by wagon to Kingman. The Fountain Head, Silver Monster, Goodwill, and Summit groups of claims were developed extensively by the Peerless Mines Development Co. The property is opened by a vertical shaft 185 feet deep, 1,000 feet of drifts, and a 1,000-foot tunnel. The ore exposed carries the sulphides of lead, zinc, and iron.

Weaver district (Mocking Bird, Virginia).—At the Zeroleene claim, which was operated a short time, a small testing plant (amalgamation and cyanidation) recovered gold bullion from ore and tailing.

[12] United States Smelting, Refining & Mining Co. Nineteenth Ann. Rept. for 1924.

PIMA COUNTY

In 1924 the production of all metals in Pima County increased in quantity and value. The largest increase was in the output of copper from the low-grade disseminated ores mined in the Ajo district and treated by leaching and concentration. The number of producers decreased from 39 to 29. The ore increased from 1,851,359 to 3,010,553 tons, gold from $3,322 to $228,470, silver from 59,036 to 208,745 fine ounces, copper from 43,144,413 to 67,279,575 pounds, lead from 331,863 to 415,953 pounds, and total value from $6,417,190 to $9,215,229. Pima and Pinal Counties were the only ones in which there was a general increase in both quantity and value of output. Ore of shipping grade aggregated 25,488 tons, carrying metals valued at $512,819. Milling plants treated 203 tons of ore that yielded gold and silver bullion having a total value of $3,330. The placer output amounted to $210 in gold and 2 ounces of silver.

Ajo district.—The New Cornelia mine,[13] the only producer in the Ajo district, was continuously active and produced 2,984,862 dry tons of ore. Part of the ore, amounting to 1,195,036 dry tons, averaging 1.394 per cent of copper, was leached. The soluble copper in the carbonate ore averaged 1.186 per cent and the insoluble copper 0.265 per cent. The ore sent to the flotation plant, 1,789,826 dry tons, averaged 1.606 per cent of copper; the sulphide ore assayed 1.225 per cent, and the oxide 0.381 per cent. The leached ore yielded 22,746,882 pounds of electrolytic copper and 1,729,479 pounds of cement copper, and the concentrate contained 39,407,932 pounds of copper. Altogether 63,884,293 pounds of copper was reported in 1924. The estimated ore reserves at the end of the year were as follows: Carbonate ore containing more than 0.8 per cent of copper, 4,071,099 tons, averaging 1.27 per cent; sulphide ore having 0.8 per cent to 3 per cent of copper, 54,200,947 tons, averaging 1.32 per cent, and sulphide ore with more than 3 per cent of copper, 2,410,544 tons, averaging 3.66 per cent. The acid leaching plant at the New Cornelia began operations in April, 1916, treating successfully the greater part of the carbonate and oxide ores. Removal of these ores partly exposed a large body of sulphide ore. To treat the sulphide ore a flotation plant[14] of 5,000 tons capacity was completed March 29, 1924. Provision was made in the layout of the plant for increasing the capacity to 10,000 tons after the leaching ore is exhausted. During November and December the plant treated an average of 6,417 tons a day. At this plant the ore is reduced in gyratory crushers, Symons horizontal disk crushers, and Marcy rod mills, and is ground to 48 mesh. The company estimates that the leaching and flotation plants can produce 8,000,000 pounds of copper a month when treating ore of average grade.

Amole district.—The Old Yuma property, developed by the International Ore Separation Co., was operated until October and 590 tons of ore were shipped to El Paso, Tex. The mine is worked by the glory-hole system and developed by inclined shafts and drifts. Part of the wet mill was converted into a dry concentrator, but after operating for about six months the mine was abandoned

[13] New Cornelia Copper Co. Ann. Rept. for 1924.
[14] Burch, H. K., New Cornelia concentrating mill at Ajo, Ariz.: Eng. and Min. Jour.-Press, vol. 118, Nov. 22, 1924, p. 808.

for lack of ore. At the Pola Verde mine development was suspended in May, pending the construction of a power line. The power plant in use was too small to complete the 1,000-foot shaft, of which only 200 feet was sunk in 1924. Sulphide ore carrying $10 in gold and silver to the ton, 5 per cent of lead, and 15 per cent of zinc has been developed. The ore body is a replacement in limestone near granitic sills.

Arivaca district.—Two small lots of gold bullion were reported by merchants as recovered from ore treated in the district.

Baboquivari district.—The Chance group of claims of the Allison Mining Co., under various managements during 1924, produced gold and silver bullion and concentrate. A four-stamp mill, capacity 10 tons a day, was active a short time.

Cobabi district (*Comobabi*).—The Little Mary mine shipped some lead ore and was the only producer in the Cobabi district.

Empire district.—All the ore reported by five producers in the Empire district was of smelting grade; it amounted to 466 tons and contained $157 in gold, 2,352 ounces of silver, 2,262 pounds of copper, and 183,215 pounds of lead, valued in all at $16,686. Most of the ore was oxidized and came from the Lone Mountain property. The Forty-nine mine, which was worked by the St. Louis Smelting & Refining Co. after the 1st of June, produced ore that averaged about 6 ounces of silver to the ton and 22 per cent of lead. Pantano, on the Southern Pacific Railroad, is the shipping point, and the freight rate to El Paso, Tex., is $2.80 a ton. Other properties producing were the La Plata, Lead Carbonate, and Verde Queen.

Greaterville district.—Placers in the Greaterville district yielded small lots of gold dust that were sold to merchants in the neighboring towns by Mexican and Indian miners. The Quebec mine and the Providence property were being developed during part of 1924.

Helvetia district.—Four producers of ore in the Helvetia district reported a total output of 202 tons, containing $31 in gold, 1,459 ounces of silver, 33,585 pounds of copper, and 9,018 pounds of lead, valued in all at $6,130. Most of the ore contained copper and was mined by lessees at the Rosemont mine and the Copper Duke claim. The Glance and Dimple claims produced oxidized silver-lead ore.

Pima district (*Olive, San Xavier, Twin Buttes*).—Four mine operators in the Pima district shipped 16,069 tons of ore of smelting grade, which contained $324 in gold, 33,165 ounces of silver, 1,907,499 pounds of copper, and 18,309 pounds of lead, valued in all at $273,892, or $17.04 a ton. The Copper Queen mine of the Midland Copper Co. was the largest producer of ore, very little of which was oxidized. The mine was active the entire year, and approximately 3,000 feet of development work was done. Dividends paid to stockholders amounted to $16,800, making the total dividends to date $46,800. Small lots of lead ore were shipped from three prospects.

Quijotoa district.—The Ajo Mines Corporation, working a prospect 42 miles southeast of Ajo, in the Quijotoa district, shipped lead-silver ore. A cyanide plant was reported under construction on the Ben Lomand or Alex McKay property, at the south end of the Quijotoa Mountains.

Santa Rosa district.—The Sterling property, 45 miles southwest of Casa Grande, in the Sheridan Mountains, yielded a small quantity of copper ore containing considerable gold.

Silver Bell district.—Early in 1924 the largest producer in the district, the Red Rock group, formerly operated by the Calumet & Arizona Mining Co., passed to the hands of a trustee for the owners. The property produced 7,726 tons of oxidized copper ore, valued at $215,800, and after a royalty of $10,098 was deducted a net profit of $26,080 remained for dividends. Shipments of lead-silver ore were made by the International Ore Separation Co. from the Indiana-Arizona mine. Lessees at the Imperial mine shipped a small quantity of copper ore.

PINAL COUNTY

The production in Pinal County showed large increases—ore from 2,784,011 to 3,137,942 tons, gold from $75,400 to $171,588, silver from 354,398 to 709,301 fine ounces, copper from 68,592,790 to 93,198,060 pounds, lead from 75,506 to 362,532 pounds, and total value from $10,454,431 to $12,884,769. The number of producers was 22, a loss of 16. Most of the ore came from the mines at Ray. Nearly all of it, or 3,071,121 tons, was of concentrating grade and produced 264,500 tons of copper concentrates. The ores of smelting grade aggregated 66,821 tons. One operator reported a small amount of placer bullion.

Banner district.—Sulphide lead ore from the Alvarado property carried 0.16 to 0.72 ounce of gold and 3 to 13 ounces of silver to the ton, and averaged about 25 per cent of lead. Some of the ore contained between 8 and 12 per cent of zinc.

Bunker Hill district (Copper Creek).—Three producers in the Bunker Hill district reported the output of 268 tons of ore, all of which was of shipping grade and contained $877 in gold, 6,893 ounces of silver, 32,482 pounds of copper, and 127,158 pounds of lead, valued in all at $19,923. The Bunker Hill mine produced the greatest quantity of sulphide copper ore and copper-lead ore. Claims now operated by the Aravaipa Metals Co., but formerly known as the Fortuna mine, about 1½ miles south of Aravaipa Canyon, produced ore carrying an average of more than 100 ounces of silver to the ton and 14 per cent of copper.

Casa Grande district.—The Orphan Boy property, 22 miles southwest of Casa Grande, produced several small lots of silver-lead ore. At the Greenback property gold ore was being developed.

Goldfields district.—The property of the Goldfield Mining & Milling Co. was operated by a lessee, but no production was recorded.

Mineral Creek district (Ray, Kelvin).—The Ray Consolidated mine [15] produced 2,898,739 tons of ore, averaging 1.52 per cent of copper, which was shipped to the mill at Hayden, and 17,879 tons of ore, averaging 1.50 per cent of copper, was shipped to the smelter for fluxing purposes. Altogether 2,916,618 tons of ore, averaging 1.52 per cent of copper, was shipped to Hayden. The mining cost

[15] Ray Consolidated Copper Co. Sixteenth Ann. Rept. for 1924.

was $1.10 a ton, compared with $1.09 a ton in 1923. These costs do not include depreciation or the usual charge of 15 cents a ton to cover extinguishment of mine development. Of the total cost, coarse crushing and loading amounted to 4 cents a ton, leaving a net mining cost of $1.06 a ton. The total ore milled was 2,896,700 dry tons, corresponding to a daily average of 7,914 tons. The average recovery was 78.27 per cent of the entire content, equivalent to 23.84 pounds of copper to the ton, as compared with 74.87 per cent, or 23.52 pounds, for 1923. The concentrate recovered amounted to 206,360 dry tons, averaging 16.73 per cent of copper. The recovery of sulphide copper averaged 85.69 per cent and the recovery of carbonates and other oxidized minerals was 33.10 per cent. The milling cost, excluding charge for depreciation, for which there was no cash outlay, was 60 cents a ton, as compared with 64 cents in 1923. The following paragraphs are from the company's annual report:

The gross production of copper from all sources, as compared with the two previous years, was as follows:

	1922	1923	1924
Copper in concentrates.....pounds..	28,632,158	63,275,229	69,053,918
Copper from direct smelting ore.....do....	432,419	428,920	536,473
Total production from all sources.....do....	29,114,577	63,704,149	69,590,391

The net production for the year from all sources, after allowing for smelter deductions, was 67,017,981 pounds, as compared with 61,385,205 pounds and 27,953,408 pounds for the years 1923 and 1922, respectively. * * *

The property was operated at considerably less than full capacity, six of the eight sections of the Hayden mill being kept in commission throughout the year.

The equipment at both mines and mill has been maintained in first-class condition, and all major improvements now contemplated at mines and mill are nearly finished, except reconstruction of the flotation plant, which will involve only moderate outlay as the necessary buildings and much of the apparatus are already available.

Costs were lower for the year than for the previous one, notwithstanding hindrances to operation by construction interferences, which prevented the full benefits of improvements being realized before the close of the year.

One car of sulphide ore assaying 38.9 per cent of lead, 7 per cent of zinc, and a little silver was shipped to El Paso, Tex., from the Integrity Group, 5 miles west of Ray. Similar ore was shipped from the McCallum claims, about 2½ miles from Ray, in Rustler's Gulch. The largest shipments, mostly of carbonate lead ore, were from the property of the Ray Silver Lead Mining Co., which mined the ore from replacement deposits in fissures and along porphyry dikes intrusive in limestone.

Old Hat district.—The ore output reported by three producers in the Old Hat district amounted to 13 tons, containing $319 in gold, 119 ounces of silver, and 2,819 pounds of copper, valued in all at $768. The ore was hauled 20 to 33 miles to Hayden. Most of it was from the Victoria, Chief & New Year, and Aetna properties. Merchants bought small lots of placer gold.

Pioneer district (*Superior*).—The only producer in the Pioneer district in 1924 was the Magma Copper Co.[16] Altogether 222,307 tons of all classes of ore was mined, averaging 67.4 cents in gold and 2.797 ounces of silver to the ton and 6.115 per cent of copper. The 600-ton concentrator was in operation the entire year, and at the new smelter, which has been fully described,[17] the first copper from the converters was poured March 29. From the crude ore and concentrate smelted the bullion, after the deduction of all losses, including refining, returned 23,301,511 pounds of copper, 533,204 ounces of silver, and 7,588.52 ounces of gold. The net cost of producing copper after deducting the value of the gold and silver was 7.87 cents a pound. This cost does not include any allowance for depreciation or interest, but includes all other fixed and general expenses. The average price realized per pound of copper was 12.865 cents in excess of all commissions. The average mill heads for 1924 contained 4.21 per cent of copper, and tailing 0.259 per cent of copper, representing an average extraction of 95.8 per cent. The mill ore carried, in addition to its copper, about 2.32 ounces of silver and 56.7 cents in gold to the ton. The ratio of concentration is about 3 to 1. The direct smelting sulphide ore averages about 15.5 per cent of copper, 6.53 ounces of silver, and $1.04 in gold to the ton. The oxidized ore smelted averaged about 10.5 per cent of copper, 9.24 ounces of silver, and $1.12 in gold to the ton. The company's annual report continues as follows:

> During the past year underground exploration work was chiefly confined to prospecting for new ore shoots in the eastern part of the mine. * * *
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> Although insufficient work has been done to date to say definitely that the ore from the 1,200-foot level to the 2,000-foot level will be continuous, it would appear that there might be this possibility, and if it should prove to be the case this new shoot should produce a considerable tonnage of ore.
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> No. 3 shaft has been completed to 84 feet below the 2,250-foot level. The main crosscut between No. 2 and No. 3 shafts has been enlarged to haulage drift size. The station and an ore pocket at No. 2 shaft on the 2,250 level have been completed, and a main west footwall haulage drift has been started. The 2,250 level will be the next main haulage level below the 2,000 level.
>
> The mine has satisfactorily furnished the required tonnage for smelting operations. The original estimates called for a production of 600 tons per day, and the average production for the year was 617 tons per day.

A low-grade complex ore with a siliceous gangue containing copper, gold, silver, lead, zinc, manganese, and iron is said to be developed in the Doggs group of claims. About 4,000 feet of development work was done, most of it on the 700-foot level, between May 15 and the close of the year.

Riverside district.—At the Prosperity claim and the property of the Buell estate copper ore was mined during development work.

Saddle Mountain district.—Silver ore carrying gold was shipped to the smelter at Hayden from the mine operated by the Adjust Mining Co. The ore is transported by burros 3 miles to Christmas, the shipping point on the Arizona Eastern Railroad. At the mine a fissure in andesite is developed by a 1,400-foot tunnel.

Summit district.—The Lorraine Copper Co., working the Fuhrmann property, shipped several lots of copper ore.

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[16] Magma Copper Co. Ann. Rept. for 1924.

[17] The new Magma copper smelter: Eng. and Min. Jour.-Press, Nov. 1, 1924, pp. 685–693

SANTA CRUZ COUNTY

Thirty-two producers in Santa Cruz County reported an output of 3,932 tons of ore, or 2,806 tons less than was reported by 29 producers in 1923. Ore of shipping grade amounted to 3,907 tons, valued at $153,618. At milling plants 25 tons of ore yielded gold and silver bullion having a total value of $441.

Harshaw district.—Seven mine operators in the Harshaw district reported the production of 1,291 tons of ore of shipping grade, which contained $424 in gold, 29,764 ounces of silver, 18,124 pounds of copper, and 190,780 pounds of lead, valued in all at $38,003, or $29.44 a ton. The Trench mine produced the largest quantity of lead ore, followed by the Hardshell, World's Fair, and Flux mines. The American claim was a large producer of silver ore, which was shipped to Douglas and used for lining converters. Operations were resumed at the Blue Nose mine, an old producer, but no ore was shipped.

Oro Blanco district.—Small lots of old slag and precipitates from the clean-up of old milling plants in the Oro Blanco district were sold through local buyers.

Pajarito district.—Five small producers in the Pajarito district reported the output of 29 tons of ore, containing $321 in gold, 1,124 ounces of silver, a little copper, and 22,901 pounds of lead. The chief producing claims are about 18 to 25 miles west of Nogales and 1 to 4 miles north of the Mexican line. A small Kinkaid mill equipped with a Wilfley table was erected in 1916 in Peña Blanco Canyon, and since has been used intermittently to concentrate ore from the Bear Chloride, White Oak, and Big Steve properties. Other properties producing in 1924 were the Sunset, Tin Can, and St. Patrick.

Palmetto district.—Lead ore from the Jarillas group was sold to a local ore buyer.

Patagonia district (*Washington, Duquesne*).—Nine mine operators in the Patagonia district produced 1,868 tons of ore of shipping grade, containing $886 in gold, 21,657 ounces of silver, 59,044 pounds of copper, and 535,191 pounds of lead, valued in all at $65,946, or an average of $35.30 a ton. Most of the output from the Kansas mine of the Duquesne property was mined by lessees, who hauled it 18 miles south to Zorilla, Sonora, Mexico, on the Southern Pacific Railroad. Lead ore was shipped from the Mowry and Tres de Mayo properties, and copper ore from the Morning Glory mine.

Red Rock district.—Oxidized lead ore shipped to the smelter from the Frisco Fair claim contained 12 ounces of silver to the ton and 30 per cent of lead.

Tyndall district (*Alto*).—Five producers in the Tyndall district reported the shipment of 552 tons of ore, containing $589 in gold, 8,365 ounces of silver, 11,888 pounds of copper, and 276,140 pounds of lead, valued in all at $29,842, or $54.06 a ton Considerable ore, the larger part oxidized lead ore, was shipped from the Alto property. Most of this ore was from the claims of the Bacca Float land grant, on which a number of lessees were busy.

Wrightson district.—The Ivanhoe property produced two lots of silver ore of shipping grade, and lessees shipped lead ore from the Mansfield and Jose Andreda claims. A car of slag from the old smelter at Crittenden was valuable enough for resmelting.

YAVAPAI COUNTY

In Yavapai County, the quantity of all the metals produced was less in 1924. There were 43 producers, 30 less than in 1923. The output of ore decreased from 1,594,268 to 1,407,479 tons, gold from $1,902,378 to $1,239,157, silver from 2,879,763 to 2,269,788 fine ounces, copper from 147,718,492 to 143,348,230 pounds, lead from 226,953 to 118,041 pounds, and the total value from $25,994,289 to $21,547,976.

No zinc was reported in 1923 or 1924. Of the first-class ore shipped to smelters most (1,311,305 tons) was sulphide copper ore. The average value of the smelting ore was $15.50 in metals a ton. Concentrates amounting to 4,154 tons, derived from 32,295 tons of ore, carried metals valued at $236,114. The placer output was $2,226 in gold and 20 ounces of silver, against $4,485 in gold and 38 ounces of silver in 1923.

Agua Fria district.—At the Arizona Binghampton mill 24,624 tons of ore were treated by concentration and flotation, and 2,795 tons of argentiferous copper concentrate were shipped to the Hayden smelter. From a lease on the Iron King mine 1,100 tons of low-grade ore containing copper was shipped to the Humboldt smelter.

Big Bug district.—Four producers in the Big Bug district reported 10,385 tons of ore, containing $14,361 in gold, 20,184 ounces of silver, 852,394 pounds of copper, and 7,152 pounds of lead, valued in all at $140,120, or $13.49 a ton. Smelting ore amounted to 8,034 tons and contained 584.50 ounces of gold, 14,722 ounces of silver, and 751,868 pounds of copper. Ore concentrated amounted to 2,347 tons and produced 544 tons of concentrates, which contained 107.77 ounces of gold, 5,460 ounces of silver, 100,526 pounds of copper, and 7,152 pounds of lead. Copper ore from the Blue Bell mine was concentrated at Humboldt, and the concentrate, together with much first-class crude ore, was smelted at Humboldt and Hayden. After the closing of the Humboldt smelter early in 1924 some ore was stored at Blue Bell siding, and about 500 tons at Humboldt. Two hundred and thirty tons of ore from the mine of the Arizona Silver Co. was milled. This ore consisted mainly of lead sulphides, carrying silver with a little copper, zinc, and gold, and yielded silver-lead concentrates containing some zinc, which was penalized. The ratio of concentration was about 15 tons to 1. The 60-ton mill, which contains 3 Callow cells and 2 Wilfley tables, was operated only about two weeks. The mine is opened by an inclined shaft 545 feet deep and another shaft 220 feet deep. In the vicinity of Mayer small lots of placer bullion were produced, but as they were sold through merchants and banks it is difficult to determine the total quantity of such bullion recovered during the season.

Black Canyon district.—Four producers in the Black Canyon district reported the output of 161 tons of ore, containing $550 in gold, 3,948 ounces of silver, and 274 pounds of copper, valued in all at $3,231. The Golden Belt claim produced 27 tons of gold ore, which was shipped to a copper smelter. The 50-ton concentration-flotation mill of the Howard Silver Co. treated a small lot of silver ore containing a little lead and zinc. A little gold ore was treated at

the Gloriana mine, and one lot of rich silver ore was shipped from the Good Luck.

Black Hills district.—About 1,200 feet of development work was done on the property of the Shea Copper Co.

Castle Creek district.—In the course of development work the Lincoln Operating Co. produced copper ore of milling grade, which was tested in a flotation plant. Lead concentrate and gold and silver bullion were shipped from the mill handling ore from the Robey mine.

Copper Basin district.—The Copper Basin placer was worked a short time and yielded a little bullion having a fineness of 0.801 gold and 0.195 silver.

Eureka district.—The management of the Arizona Bagdad Co. believes that copper can be produced by leaching the ore "in place." Experimental work has been confined to an area approximating 300 feet square. The Hillside property was not active, but it is said to have a reserve of 48,000 tons of ore valued at $21.46 a ton in gold, silver, and lead. About 10,000 tons of old tailing at the mill is reported to average 0.25 ounce of gold and 6 ounces of silver to the ton.

Hassayampa district.—From the Mark Twain group, which is under development, sulphide lead ore was shipped to El Paso, one lot of gold ore to Hayden, and ore carrying 16 per cent arsenic to Martinez, Calif. A little gold bullion was produced at the Sunset property by a small steam stamp mill. Several small lots of placer bullion ranging in fineness from 0.839 to 0.859 in gold were produced by transient miners.

Martinez district.—The Washington and Lincoln claims produced a little first-class gold ore, and experimental work on old tailings of the Congress mine resulted in the shipment of a little gold bullion.

Peck district (Ocotillo).—The Curtin claim, developed by the Brestlin Mining Co., produced considerable silver ore of shipping grade, but operations were discontinued in September.

Silver Mountain district.—Ore from the Gold Blossom claims was treated in the 5-ton Gibson mill on Ryland Creek, 11 miles east of Wagoner, and a little gold bullion was marketed.

Tip Top district.—The Kay Copper Corporation, operating at Canon, in the extreme southeast corner of Yavapai County, 50 miles north of Phoenix, is said to have uncovered 30 feet of sulphide copper in its crosscut on the 1,200-foot level from the No. 4 shaft, which was completed to that level in June.

Turkey Creek district.—Operators of the Goodwin mine, which is opened by a shaft 138 feet deep, shipped a small quantity of hand-sorted ore containing silver and a little copper.

Verde district (Jerome).—The ore mined from the United Verde and United Verde Extension mines was directly smelted. The United Verde Copper Co. completed its No. 6 shaft, which is used for transferring men and supplies, by sinking from the 1,950 to the 2,400 level. The No. 5 shaft, which has been exclusively used for ore, was deepened from the 2,500 to the 3,000 level. Blast furnaces and reverberatories are used at the Clarkdale plant. The matte produced is converted to blister copper and shipped as such. The converter slag

is retreated in the reverberatories, as is the dust from flues and Cottrell treaters. Ore for the blast furnaces is crushed to 3-inch size before smelting. The general flow sheet and a description of the plant have been recently published.[18] In July the smelter output exceeded 10,000,000 pounds of copper, which is said to be the largest monthly production ever recorded. Stripping at Jerome opened the old firestope area for mining. Most of the ore is said to come from the pits, in which four steam shovels were busy. Some of the highly siliceous or so-called schist ore from the pits was shipped to Humboldt for experimental treatment in the concentrator of the Southwest Metals Co., which has been closed since October, 1923.

Development of the United Verde Extension [19] and Jerome Verde ground continued. In the United Verde Extension drifting on all the levels did not cut any additional veins more important than those cut in 1923. On the 1,600 and 1,700 foot levels a body of low-grade pyrite ore, an extension of the main ore body, was found southwest of the Edith shaft. In the Jerome Verde mine exploration northward on the eastern side of the main fault was continued almost to the northern boundary without finding any commercial ore and was abandoned. Ore reserves above the 1,600-foot level showed little change. At the smelter of the United Verde Extension Co. reverberatory No. 1 ran 219 days, No. 2, 130 days, and the blast furnace, 89 days. The output of the year from 185,858 dry tons of ore smelted, 1,446 dry tons shipped, and 684 dry tons of custom concentrate smelted was 44,278,947 pounds of copper. The cost of mining in 1924 was 2.84 cents per pound of copper produced, smelting 2.61 cents, freight on ore 0.08 cent, freight on bullion and refining and selling 1.87 cents, and other expenses 0.09 cent, or a total of 7.49 cents a pound. Dividends paid to stockholders amounted to $2,625,000. The story of the United Verde Extension and the finding of the large ore body through the application of geology has been interestingly told by Rickard.[20]

At the Verde Central mine, which has been in course of development since July, 1921, the three-compartment vertical shaft is down 1,476 feet, and the present work is mainly below the 850-foot level. The ore deposit, opened on the 1,400-foot level, is 5 to 40 feet wide. Chalcopyrite, which occurs as a replacement of schist, quartz porphyry, and greenstone, is the chief ore mineral. The company report [21] says:

> The raise from the 850-foot level was completed to the 670-foot level, showing the ore to be continuous. No. 1009 drift was extended southerly from No. 1019 a distance of 232 feet, showing the mineralization to be continuous to that point, where it consists of highly siliceous ore 15 feet wide carrying about 2 per cent copper. This addition makes the total length of mineralized ground in No. 1009 approximately 900 feet, with both faces still strong. The new 1,450-foot level should cut the downward extension of this mineralized zone 600 feet deeper and about midway of its length, at a distance of approximately 400 feet from the vertical shaft, depending on the dip.

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[18] Young, G. J., The United Verde smelter: Eng. and Min. Jour.-Press, vol. 118, July 19, 1924, p. 97.
[19] United Verde Extension Mining Co. Ann. Rept. for 1924.
[20] Rickard, T. A., A great mining adventure: Eng. and Min. Jour.-Press, vol. 117, June 14, 1924, p. 959.
[21] Calumet & Arizona Mining Co. Ann. Rept. for 1924.

In the course of sinking the shaft chalcopyrite mineralization in the quartz porphyry began to show at 930 feet, becoming stronger as greater depth was attained. At 1,000 feet average samples of the muck showed 1.5 per cent copper. The condition continued in varying degree to about 1,440 feet, car samples running up to 3 per cent in places where heavy bunches and veinlets showed in the rock.

Walker district (Lynx Creek).—Seven producers of ore in the Walker district reported the output of 6,075 tons, part of which (4,954 tons) yielded 954 tons of concentrate, containing 636 ounces of gold, 15,402 ounces of silver, 92,347 pounds of copper, and 70,866 pounds of lead. The ore of shipping grade amounted to 581 tons; it contained 229.01 ounces of gold, 7,439 ounces of silver, 41,116 pounds of copper, and 9,925 pounds of lead. At milling plants equipped for amalgamation 540 tons of ore yielded bullion containing 86.99 ounces of gold and 24 ounces of silver. The Sheldon mine was the largest producer, though most of the year was spent in sinking the shaft. The 200-ton concentration-flotation plant constructed in 1924 is equipped with a Symons disk crusher, rod mills, classifier, concentrating tables, and flotation cells. It began work in October. Copper concentrate and crude ore were shipped to Clemenceau and Humboldt, and lead concentrate to El Paso. As the ore reserves are considerable, a large increase in production will probably result from the regular operation of the mill. Other producers were the Farnum, Express, Curran, and Alturas properties. Buyers of placer gold reported 37 ounces purchased from various persons working the gravel of Lynx Creek.

Walnut Grove district (Wagoner).—The Silver Fleece claim was worked by lessees and produced 23 tons of ore containing 15 ounces of silver to the ton and 19 per cent of lead. Small lots of placer gold were shipped to the mint at San Francisco.

Weaver district (Octave).—Much of the placer gold mined near Octave is sold locally for jewelry. Merchants, however, reported the purchase of about 15 ounces of gold, which was deposited at the mint in San Francisco.

YUMA COUNTY

The total value of the gold, silver, copper, and lead produced in Yuma County was only $51,831 in 1924, against $989,996 in 1923, because the Swansea mine, formerly a large producer of copper, was idle most of the year. Inquiries concerning the production of placer gold were not answered.

Castle Dome district.—From the operations of six deep mines 224 tons of ore was produced, containing $689 in gold, 4,012 ounces of silver, 157 pounds of copper, and 192,183 pounds of lead, valued in all at $18,773, or $83.81 a ton. The ore of shipping grade amounted to 156 tons, 27 tons of ore were concentrated, and 41 tons yielded gold and silver bullion by treatment in an amalgamation mill. The Lady Edith property produced several lots of first-class silver-lead ore. From the Bonanza claim 27 tons of ore treated by dry concentration gave a concentrate assaying 20 ounces of silver to the ton and 60 per cent of lead. Other producers were the Anna and Silver Dollar mines.

Cienega district.—The Standard Copper Co. continued the construction of its sulphuric acid leaching plant, which was expected to be operating early in 1925.

Ellsworth district.—Four producers in the Ellsworth district reported a total output of 47 tons of copper, gold, and lead ore, which had an average value of $33.96 in metals a ton.

Kofa district.—The Ironwood mine produced a little gold bullion.

Planet district (Swansea).—Only about 1,000 tons of sulphide copper ore was shipped from the Swansea mine; the Southwest Metals Co. relinquished its lease early in the year, after which the mine was idle.

Plomosa district.—The Apache Chief mine produced several lots of copper ore containing considerable silver, and the R. & A. property produced one car of rich silver ore.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By James M. Hill [1]

PRODUCTION

The gold, silver, copper, lead, and zinc produced in California in 1924 increased 9 per cent in total value as compared with 1923. Production of gold from deep mines increased 25 per cent, but the yield of the placer gold decreased 30 per cent. The total production of gold decreased less than 2 per cent. The output of silver was only 4,310 ounces (0.1 per cent) less than in 1923, but the value of silver produced decreased 18 per cent. Production of copper increased 84 per cent in quantity and 64 per cent in value. Lead production fell off 50 per cent in quantity and 43 per cent in value. There was a large output of zinc in 1924, following a year of no production.

Mine production of gold, silver, copper, lead, and zinc in California, 1920–1924

Year	Number of producing mines	Ore and tailings	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1920	500	1, 165, 022	$14, 311, 043	1, 706, 327	12, 626, 272	4, 813, 510	1, 165, 509	$18, 973, 660
1921	573	1, 215, 600	15, 704, 822	3, 629, 223	11, 743, 404	1, 124, 276	[b] 846, 184	[b] 20, 941, 845
1922	565	1, 539, 933	14, 670, 346	3, 100, 065	22, 539, 485	6, 312, 536	3, 012, 950	21, 332, 168
1923	621	1, 535, 691	13, 379, 013	3, 559, 443	28, 317, 759	9, 549, 680	----------	21, 128, 945
1924	553	2, 019, 200	13, 150, 175	3, 555, 133	52, 107, 171	4, 763, 806	3, 060, 000	22, 938, 157

[a] Includes placer production. [b] Revised figures.

Gold and silver produced at placer mines in California, 1920–1924

Year	Dredges		Drift		Hydraulic		Surface		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	
		Fine ounces		*Fine ounces*		*Fine ounces*		*Fine ounces*	
1920	$6, 900, 366	28, 918	$62, 925	374	$66, 233	413	$31, 089	195	$7, 093, 204
1921	7, 756, 787	36, 322	127, 411	615	162, 808	864	107, 818	829	8, 193, 454
1922	4, 999, 215	16, 608	252, 626	1, 391	158, 275	906	89, 739	708	5, 519, 468
1923	6, 065, 735	17, 569	184, 771	955	111, 828	626	160, 249	1, 155	6, 539, 233
1924	4, 305, 521	14, 793	98, 568	560	60, 195	409	124, 088	928	4, 599, 554

[1] Miss Helen M Gaylord, of the Bureau of Mines, assisted in the preparation of this report.

ORE

The quantity of ore and tailings treated in California in 1924 increased 31 per cent as compared with 1923. Gold ore and tailings increased 25 per cent, silver ore and tailings decreased 34 per cent, copper ore and tailings increased 61 per cent, and lead ore decreased 57 per cent. No copper-lead ore was produced in 1924 and no zinc ore in 1923. The average value of all ore and tailings treated was $9.08 a ton, of which $5.41 was in gold and silver, as compared with $9.50 and $6.35, respectively, in 1923.

Ore and metals produced in California in 1924

Source	Ore and tailings		Gold		Silver	
	Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore and tailings	986,098	48.84	383,796.60	60.33	155,869	4.38
Dry silver ore and tailings	89,760	4.44	8,255.74	1.30	2,295,683	64.58
Copper ore and tailings	917,806	45.45	21,129.50	3.32	876,293	24.65
Lead ore	16,536	.82	795.37	.13	188,098	5.29
Zinc ore	9,000	.45	200.00	.03	22,500	.63
Total, deep mines	2,019,200	100.00	414,177.21	65.11	3,538,443	99.53
Total, placers			221,962.51	34.89	16,690	.47
	2,019,200	100.00	636,139.72	100.00	3,555,133	100.00
Increase or decrease from 1923	+483,509		−11,070.03		−4,310	

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore and tailings	700		5,613	0.12		
Dry silver ore and tailings						
Copper ore and tailings	51,668,117	99.16				
Lead ore	78,354	.15	4,758,193	99.88		
Zinc ore	360,000	.69			3,060,000	100.00
	52,107,171	100.00	4,763,806	100.00	3,060,000	100.00
Increase or decrease from 1923	+23,789,412		−4,785,874		+3,060,000	

Value of metals from ore and tailings treated in California in 1924

Kind of ore	Ore and tailings (short tons)	Total value		Average value per ton	
		In gold and silver	In all metals	In gold and silver	In all metals
Dry gold ore and tailings	986,098	$8,038,212	$8,038,753	$8.15	$8.15
Dry silver ore and tailings	89,760	1,708,769	1,708,769	19.04	19.04
Copper ore and tailings	917,806	1,023,902	•7,792,425	1.12	8.49
Lead ore	16,536	142,468	533,387	8.62	32.26
Zinc ore	9,000	19,209	265,269	2.13	29.47
	2,019,200	10,932,560	18,338,603	5.41	9.08

• Includes value of copper from mine water.

Ore and tailings sold or treated in California in 1924, with content in terms of recovered metals

Dry gold ore

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	400,376	130,704.62	27,203		
Butte	4,755	2,111.85	1,461		
Calaveras	143,155	36,559.46	6,660	571	5,114
Eldorado	823	847.86	153		
Fresno	35	37.22	15		
Inyo	143	209.30	110	129	
Kern	27,408	7,274.27	41,268		
Lassen	160	108.86	65		
Los Angeles	81	34.59	5		
Madera	144	118.84	115		
Mariposa	14,813	8,675.08	2,368		
Mono	714	2,386.67	4,973		
Nevada	268,340	135,353.70	58,459		
Placer	4,714	3,176.47	548		
Plumas	3,888	1,480.85	189		
San Bernardino	1,309	895.76	408		499
San Diego	230	200.99	142		
Shasta	7,168	2,149.81	2,266		
Sierra	34,597	37,390.74	7,597		
Siskiyou	1,070	1,716.36	214		
Trinity	288	236.60	37		
Tuolumne	71,800	11,996.13	1,611		
Yuba	87	130.57	2		
	986,098	383,796.60	155,869	700	5,613
Increase from 1923	197,072	72,318.81	73,082	508	5,325

Dry silver ore

Kern	2,336	121.00	12,272		
San Bernardino	87,424	8,134.74	2,285,411		
	89,760	8,255.74	2,295,683		
Decrease from 1923	46,873	1,723.26	467,294	4,950	4,130

Copper ore

Calaveras	65,306	32.40	4,122	4,819,893	
Eldorado	2		4	503	
Inyo	18	.02	1,420	2,805	
Madera	59		131	34,468	
Mono	55	13.12	157	4,413	
Plumas	556,829	10,810.38	369,205	25,557,676	
Riverside	34	23.10	2	2,734	
Shasta	284,525	9,638.75	487,294	20,696,027	
Trinity	10,978	611.73	13,958	549,598	
	917,806	21,129.50	876,293	51,668,117	
Increase from 1923	346,161	12,605.76	515,948	23,430,065	

Lead ore

Inyo	16,151	745.06	171,298	69,847	4,612,296
Kern	1		12	55	364
Los Angeles	155	1.72	8,227	199	54,291
Mono	75	2.07	4,530	933	30,583
Orange	21		1,022	61	2,673
Riverside	54	28.65	865	6,165	26,817
San Bernardino	79	17.87	2,144	1,094	31,169
	16,536	795.37	188,098	78,354	4,758,193
Increase or decrease from 1923	−21,768	−859.01	−142,143	+11,473	−4,751,979

Zinc ore[a]

County	Ore	Gold	Silver	Copper	Zinc
Shasta	9,000	200.00	22,500	360,000	3,060,000

[a] No zinc ore produced in 1923.

GOLD

The value of gold produced in California in 1924 was $13,150,175, bringing the value of the total production of the State to about $1,777,000,000. To credit to the several counties and to placers and deep mines the gold output reported is difficult, for the origin of much of the gold that reaches the mint can not be determined. A large part of this gold is won by small mine owners who do not answer Bureau of Mines inquiries, and a considerable part undoubtedly results from operations by "high graders." For 1924 it is estimated that at least $510,000 worth of gold belongs in the "high-grade" class. Bankers and storekeepers at such centers as Sonora, Angels Camp, Jackson, Nevada City, Grass Valley, Oroville, Redding, and Yreka purchase or ship gold that comes from a considerable territory tributary to those towns and often keep no record of origin of the bullion or the persons for whom the bullion is handled. These lots are usually small, but in the course of a year they aggregate a considerable number of ounces, which must be apportioned according to the bureau's best judgment.

In 1924 there were 42 companies that produced over 1,000 ounces of gold each and contributed 91 per cent of the total gold output of California. Of these 13 operated dredges, 24 gold quartz mines, 3 copper mines, 1 a silver mine, and 1 a gravel pit. The 10 largest gold-producing companies, in order of output, were the Yuba Consolidated Gold Fields (5 dredges), Natomas Co. of California (8 dredges), Empire Mines Co. (gold quartz), North Star Mines Co. (gold quartz), Kennedy Mining & Milling Co. (gold quartz), Carson Hill Gold Mines (Inc.) (gold quartz), Argonaut Mining Co. (gold quartz), Sixteen to One Mines Co. (gold quartz), Central Eureka Mining Co. (gold quartz), and Marysville Dredging Co. (1 dredge). These companies were also the largest producers of gold in 1923, but the relative production of the last seven has changed.

Four counties each produced more than $1,000,000 in gold in 1924, but Calaveras fell below that figure. Nevada and Amador Counties, whose production is from gold quartz mines, exceeded Yuba and Sacramento Counties, whose dredge yield was considerably less than in 1923. The chief producing counties in 1924 were Nevada, $2,820,032; Amador, $2,706,508; Yuba, $1,995,434; and Sacramento, $1,150,687.

In 1924, deep mines produced 65 per cent and placer mines 35 per cent of the total gold output, as compared with 51 per cent and 49 per cent in 1923.

The yield of placer gold in 1924 was valued at $4,588,372, a decrease of 30 per cent as compared with 1923. The decrease was attributable almost entirely to 29 per cent decrease in yield of dredges, which produced 94 per cent of the total gold mined at placers, though because of drought conditions all classes of placer mining showed a decided decline in production. In 1924, 27 dredges, 51 drift mines, 47 hydraulic mines, and 141 surface placers were operated. Drift mining yielded 47 per cent, hydraulic mining 46 per cent, and surface or sluice mining 23 per cent less gold than in 1923. There was a considerable decline in the dredge production of Yuba and Shasta Counties; in fact, the only gold-dredging counties that

showed a larger yield were Butte and Stanislaus. The yield in gold from drift mines was $86,203 less than in 1923. There was a large increase in gold from drift mines in Sierra County and smaller gains in Eldorado, Mariposa, Plumas, Shasta, Trinity, and Tuolumne Counties, but declines in yield from drift mines in Butte, Calaveras, Nevada, Placer, and Yuba Counties. Gold produced at hydraulic mines in 1924 decreased $51,633 as compared with 1923. Mines in Siskiyou and Trinity Counties were, as usual, most productive, though the production of hydraulic mines in both was less than in 1923. Surface mining yielded some gold in every county of the State that reported production from placers, but the individual yield of this class of mining was relatively small.

The production of gold from deep mines was valued at $8,561,803, an increase of 25 per cent as compared with the figures for 1923. The counties that led in deep-mine production of gold in 1924 were, in order of output, Nevada, Amador, Sierra, Calaveras, Plumas, Tuolumne, and Shasta. Mines in Calaveras, Sierra, and Tuolumne yielded less, but mines in Amador, Nevada, Plumas, and Shasta Counties yielded considerably more—in Amador and Nevada from gold ore and in Plumas and Shasta from copper ore. Of the 267 deep mines that reported output, 29 produced gold in excess of $20,000, but only 2 in excess of $1,000,000. Nevada County maintained its lead as a producer of gold from deep mines, but Amador ran a close second. Practically 93 per cent of the gold produced by deep mines was from dry gold ore and tailings, 5 per cent from copper ore and tailings, and almost 2 per cent from silver ore and tailings. Of the total gold from deep mines, 64 per cent was saved by amalgamation, 15 per cent by cyanidation, 15 per cent by smelting, and 6 per cent by hand mortaring "high grade."

SILVER

The production of silver in 1924 was 3,555,133 ounces, only 4,310 ounces less than in 1923, but the value decreased 18 per cent. Ninety-nine per cent of the total silver output of California in 1924 was produced by 49 mines that contributed over 1,000 ounces each. Between 1,000 and 5,000 ounces was produced at 25 properties, between 5,000 and 10,000 ounces at 8, between 10,000 and 50,000 ounces at 11, between 100,000 and 300,000 ounces at 4, and more than 2,000,000 ounces at 1 (California Rand Silver (Inc.)). The four mines with an output of between 100,000 and 300,000 ounces were copper mines in Plumas and Shasta Counties. No lead mine produced over 50,000 ounces of silver in 1924. San Bernardino County held first rank in silver production, followed by Shasta and Plumas Counties. The 10 largest producers of silver in the State, named in order of output, were the California Rand Silver (Inc.) (silver ore); U. S. Smelting, Refining & Mining Co. (Mammoth mines) (copper ore); Walker Mining Co. (copper ore); Engels Copper Co. (copper ore); Tecopa Consolidated Mining Co. (lead ore); Darwin Silver Co. (lead ore); Zenda Mining Co. (gold ore); Cerro Gordo Mines Co. (lead ore); Estelle Mines Co. (lead ore); and Empire Mines Co. (gold quartz).

Except for the great expansion of copper mining, the silver output would have declined more than it did, for the lead mines were much less productive in silver and the output of the California Rand

declined considerably. The silver production of Shasta County increased nearly ninefold, due to the greater extent of copper mining, and there were notable increases in yield of silver from Amador, Kern, Los Angeles, Mono, Nevada, Plumas, and Trinity Counties.

In 1924 the yield of silver from placer mines was 16,690 ounces, less than one-half of 1 per cent of the State total and a decrease of 18 per cent as compared with 1923. The dredges produced 89 per cent, surface placers 6 per cent, drift mines 3 per cent, and hydraulic mines 2 per cent of the silver yield of placer mines.

The production of silver from deep mines was 3,538,443 ounces, a decrease of only 695 ounces, but because of the lower price of silver the value decreased 18 per cent as compared with 1923. In 1924 silver ore and tailings, practically all from San Bernardino County, yielded 65 per cent, copper ore and tailings 25 per cent, lead ore only 5 per cent, and gold ore and tailings 4 per cent of the total silver produced in the State. Smelters recovered 95 per cent of the silver yield, and three-fourths of this came from the smelting of silver and copper concentrates. The recovery of silver from ore at gold and silver mills was over 3 per cent of the total, a little over half of this being by amalgamation.

COPPER

The copper production of California in 1924 was 52,107,171 pounds, valued at $6,826,039, an increase of 84 per cent in quantity and 64 per cent in value as compared with 1923. The largest output was from Plumas County, followed by Shasta, Calaveras, Trinity, and Inyo Counties. The largest increase in yield was in Shasta County—over 17,000,000 pounds. Plumas and Calaveras Counties increased their output by about 3,000,000 pounds each, and Trinity County nearly doubled its yield.

Copper ore mined in 1924 supplied 96 per cent, tailings and copper recovered from mine water nearly 3 per cent, and zinc ore nearly 1 per cent of the total copper produced. Smelters recovered 97 per cent of the total copper—39 per cent from crude smelting ore and 58 per cent from copper concentrates.

LEAD

Inyo County mines were only half as productive as in 1923, which accounts for the considerable decrease in lead production in 1924. A mine on Santa Catalina Island and a property out from Vidal, San Bernardino County, began shipping lead ore in 1924.

Practically all of the lead produced in 1924 came from lead ores carrying silver and a little gold and copper, although a few thousand pounds of lead was recovered by the smelting of dry gold ore. The lead was recovered by smelting—nearly 85 per cent from the smelting of lead ore averaging about 20 per cent lead and 15 per cent from lead concentrates that averaged 43 per cent lead.

ZINC

The Bully Hill mine, in Shasta County, was again productive, as it had been reopened by the California Zinc Co. A new flotation mill and reverberatory furnace were built, and zinc oxide containing 3,060,000 pounds of zinc was recovered.

METALLURGIC INDUSTRY

In 1924 the tonnage of ore treated at gold and silver mills in California increased 11 per cent as compared with 1923; the increase at amalgamation mills was 68,945 tons and at cyanide plants 13,235 tons. Of the gold recovered from ore at the mills 90 per cent was saved by amalgamation and 10 per cent by cyanidation; of the silver from ore, 53 per cent was saved by amalgamation and 47 per cent by cyanidation.

Concentrates produced at California mills in 1924 amounted to 17,981 tons more than in 1923 and carried 39 per cent more gold, 2 per cent more silver, and 34 per cent more copper, but 60 per cent less lead than in 1923. Copper concentrates constituted 73 per cent, gold concentrates 17 per cent, silver concentrates 9 per cent, and lead concentrates 1 per cent of the total in 1924. The quantity of copper, gold, and silver concentrates was larger than in 1923, but the quantity of lead concentrates was less. The practice of cyaniding gold concentrates diminished; 2,142 tons less were treated than in 1923. Only 8 per cent of the total concentrates in 1924 was cyanided; the balance was smelted.

California ore smelted in 1924 increased 360 per cent as compared with 1923. The increases were in copper ore (174,012 tons), gold ore (9,483 tons), and zinc ore (9,000 tons). The quantity of silver ore smelted in 1924 was 2,236 tons less and lead ore 5,507 tons less than in 1923. The average content of the gold ore smelted dropped greatly, because a considerable tonnage of very low-grade ore was smelted largely for its value as flux.

Metallurgic recovery of metals in California in 1924

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	793,052	264,694.79	65,268			
Ore cyanided	29,447	28,396.29	56,957			
Concentrates cyanided	6,897	25,147.32	14,149			
Tailings amalgamated	50	209.69	56			
Tailings cyanided	88,750	9,990.78	3,902			
Ore smelted	236,018	14,455.01	805,783	20,421,665	4,028,306	3,060,000
Concentrates smelted	78,686	46,653.00	2,581,668	30,192,637	735,500	
Tailings smelted	94,067	71.23	5,127	[a]1,492,869		
Hand mortared		24,559.10	5,533			
		414,177.21	3,538,443	52,107,171	4,763,806	3,060,000

[a] Includes copper from mine water.

Gold and silver produced at mills in California in 1924

County	Ore to gold and silver mills [a]	Gold in bullion	Silver in bullion
	Short tons	*Fine ounces*	*Fine ounces*
Amador	312,326	97,854.69	19,476
Butte	4,755	2,105.22	1,460
Calaveras	140,493	19,380.17	2,121
Eldorado	823	833.51	146
Fresno	35	37.22	15
Inyo	110	154.93	73
Kern	24,551	6,009.14	36,683
Lassen	160	108.86	65
Los Angeles	81	34.59	5
Madera	144	93.27	66
Mariposa	14,763	8,138.83	2,037
Mono	510	2,275.93	3,899
Nevada	268,335	114,353.81	44,062
Placer	4,714	3,176.47	548
Plumas	3,888	1,480.85	189
San Bernardino	1,656	874.86	4,060
San Diego	230	200.99	142
Shasta	522	493.28	101
Sierra	34,464	31,294.10	5,755
Siskiyou	1,020	1,680.08	208
Trinity	288	236.60	37
Tuolumne	8,544	2,143.11	1,075
Yuba	87	130.57	2
	822,499	293,091.08	122,225
Increase from 1923	82,180	18,290.94	3,136
Average content per ton	----------	0.3563	0.1486

[a] Tailings excluded.

Metals produced from California concentrates in 1924

By counties

	Ore to concentrating mills	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	----------	2,844	15,553.45	4,049	----------	----------
Butte	----------	2	6.63	1	----------	----------
Calaveras	65,321	18,308	16,516.55	8,557	4,643,391	5,114
Eldorado	----------	1	7.87	2	----------	----------
Inyo	6,296	848	54.13	40,085	8,919	728,741
Kern	----------	1	4.01	6	----------	----------
Madera	----------	5	25.57	49	----------	----------
Mariposa	----------	56	439.58	313	----------	----------
Nevada	----------	2,454	10,550.45	12,596	----------	----------
Orange	20	2	----------	670	40	1,645
Plumas	556,781	49,579	10,810.38	368,612	25,540,287	----------
San Bernardino	85,963	7,950	8,048.97	2,160,406	----------	----------
Shasta	----------	5	22.19	6	----------	----------
Sierra	130	39	302.88	47	----------	----------
Siskiyou	50	9	36.28	6	----------	----------
Tuolumne	63,255	3,480	9,421.38	412	----------	----------
	777,816	85,583	71,800.32	2,595,817	30,192,637	735,500
Increase or decrease from 1923	+62,534	+17,981	+20,242.55	+42,253	+7,622,774	−1,084,487

By kinds of concentrates

Dry gold	14,043	52,859.12	21,934	571	5,114
Dry silver	7,950	8,048.97	2,160,406	----------	----------
Copper	62,741	10,842.78	372,734	30,183,107	----------
Lead	849	49.45	40,743	8,959	730,386
	85,583	71,800.32	2,595,817	30,192,637	735,500

Average recoverable content

	Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*
Dry gold	3.76	1.56	----------	----------
Dry silver	1.01	271.75	----------	----------
Copper	.17	5.94	24.05	----------
Lead	.06	47.99	.53	43.01
Average	.84	30.33	17.64	.43

Metals produced from California crude ore shipped to smelters in 1924 [a]

By counties

	Crude ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Calaveras	2,647			65,999		
Eldorado	2		4	503		
Inyo	9,906	745.32	132,670	63,862	3,883,555	
Kern	5,194	1,382.12	16,863	55	364	
Los Angeles	155	1.72	8,227	199	54,291	
Madera	59		131	18,511		
Mono	134	67.49	4,749	5,346	30,583	
Nevada	5	13.00				
Orange	1		352	21	1,028	
Plumas	48		593	17,389		
Riverside	88	51.75	867	8,899	26,817	
San Bernardino	693	124.54	120,542	1,094	31,668	
Shasta	206,104	11,408.34	506,826	19,690,189		3,060,000
Sierra	3	41.78	9			
Trinity	10,978	611.73	13,958	549,598		
Tuolumne	1	7.22	1			
	236,018	14,455.01	805,783	20,421,665	4,028,306	3,060,000
Increase or decrease from 1923	+184,669	+9,846.54	−30,942	+16,186,072	−3,701,387	+3,060,000

By kinds of ore

Dry gold	9,592	3,083.09	6,972	129	499	
Dry silver	2,897	204.03	130,524			
Copper	204,299	10,221.97	498,432	19,992,141		
Lead	10,230	745.92	147,355	69,395	4,027,807	
Zinc	9,000	200.00	22,500	360,000		3,060,000
	236,018	14,455.01	805,783	20,421,665	4,028,306	3,060,000

Average recoverable content

	Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*
Dry gold	0.32	0.73			
Dry silver	.07	45.05			
Copper	.05	2.44	4.89		
Lead	.07	14.40	.34	19.69	
Zinc	.02	2.50	2.00		17.00
Average	.06	3.41	4.33	.85	.65

[a] Tailings excluded.

MINING INDUSTRY

During 1924 the mining industry of California faced drought conditions, which caused a considerable decrease of gold production by placer mines and no little inconvenience to those quartz mines dependent on water power. At a few places along the Mother Lode mill water was short, and operations had to be curtailed. Eight counties each produced metals valued at over a million dollars in 1924, as compared with seven in 1923. Plumas County, because of its copper mines, maintained its lead. Shasta County, with a large output of copper in 1924, stood second, replacing Yuba County, which dropped from second rank in 1923 to fifth in 1924, due to the decline in dredge yield. Nevada County ranked third in 1924, replacing San Bernardino, the latter county taking sixth place in 1924. Amador County, by increasing its production nearly $1,000,000, was the fourth largest producing county in 1924. Despite a decline of over $350,000 in gold, Calaveras County in seventh place was able to stay in the million-dollar class largely because of the operations of the Calaveras Copper Co.

The expansion of copper mining, particularly in Shasta and Calaveras Counties, was a feature of 1924, and the copper mines in Plumas County were a little more productive than in 1923. The output of the lead mines in Inyo County decreased about 50 per cent, notwithstanding the increased value of lead, the output of every lead-producing camp in the county being smaller. Among the deep gold mines the properties in Amador County made particularly large increases, but the gold mines of Calaveras, Sierra, and Tuolumne Counties produced less.

In the northern counties, where hydraulic mining is so important, the placer mines were badly hit by the drought conditions, and various properties on the Klamath, Salmon, and Trinity Rivers had water for only short runs, and some did not even clean up. The dredges on Trinity River were not so productive, and the Gardella dredge, near Lewiston, was destroyed late in the year. The American Gold Dredging Co. completed its work near Redding early in the year, and one of the Gardella boats burned. There was considerable development work on gold quartz properties near Etna Mills, Rollins, and Happy Camp, in Siskiyou County, and near French Gulch and Shasta, in Shasta County, but at the quartz mines of Trinity County little was done except in Eastman Gulch. The chief item of interest in the northern counties was the greatly enlarged operations of the Mammoth Copper Co. at Kennett and the reopening of the Bully Hill copper-zinc mines late in the fall.

In Plumas County the Engels Copper Co. restricted output somewhat, but the Walker mine produced more copper than in the year before. The Jamison mine at Johnsville continued production, and some development was under way at Greenville. Placer mining was not important, though gold came from several of the camps and from the Marguerite drift property out from La Porte. In Sierra County the Tightner was sold to the Sixteen to One Mines Co., which continued as the largest producer in the Alleghany district but with smaller output. Considerable development was under way in the district, and several properties were reopened. Downieville also showed signs of revival, and a number of quartz properties were rehabilitated. The placer mines were all short of water, and the large preparations at Sierra City and Scales did not result in production, as was hoped. At Graniteville and Washington, in Nevada County, several quartz mines were reopened and put on a productive basis. The Empire, North Star, and Idaho Maryland at Grass Valley increased their output, and considerable development was under way at various smaller mines near Grass Valley and Nevada City. The hydraulic and drift mines of the county had a bad year.

At the north end of the Mother Lode, in Placer and Eldorado Counties, there was more activity than for some years, and several quartz mines were productive near Placerville, Greenwood, and Colfax. Amador County was the banner producing county on the Mother Lode, with a much larger yield than in 1923 from the Kennedy, Argonaut, Moore, Plymouth, and Central Eureka mines. Calaveras County mines, except for the Calaveras Copper, were not so productive as in 1923. The Carson Hill mines were the largest gold producers in the county. At Westpoint development was under way, and several mines were productive. In Tuolumne County the Shawmut was the most important gold-quartz mine, but develop-

ment at mines near Big Oak Flat, Chinese Camp, Jamestown, and Sonora yielded some gold. The Clio, near Chinese Camp, and the Heslop, near Jamestown, were good producers. In Mariposa County the Original, at Clearinghouse, is a consistent producer, and development and production continued at the Princeton property. Young [2] has stated clearly the problems involved in mining the low-grade relatively small ore bodies of the Mother Lode.

Gold and silver recovered at gold mills in Mother Lode counties in California in 1924 [a]

County	Ore treated	Gold and silver recovered in bullion		
		Gold	Silver	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*	
Amador	312,326	97,854.69	19,476	$6.52
Calaveras	140,493	19,380.17	2,121	2.86
Eldorado	823	833.51	146	21.05
Mariposa	14,763	8,138.83	2,037	11.49
Tuolumne	8,544	2,143.11	1,075	5.27
	476,949	128,350.31	24,855	5.60

County	Concentrates produced [b]	Gold and silver recovered from concentrates			Value of total recovery	
		Gold	Silver	Average value per ton of concentrates	Total	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*			
Amador	2,844	15,553.45	4,049	$114.01	$2,360,116	$7.56
Calaveras	4,763	15,611.53	3,290	68.22	726,968	5.17
Eldorado	1	7.87	2	164.00	17,492	21.25
Mariposa	56	439.58	313	166.02	178,907	12.12
Tuolumne	159	445.18	359	59.40	54,466	6.37
	7,823	32,057.61	8,013	85.40	3,337,949	7.00

[a] Tailings excluded. [b] Includes only concentrates made from gold ores.

In southern California the California Rand Silver was the outstanding figure in California mining. The Zenda, at Caliente, continued operations, and at Mojave there was more activity, and considerable siliceous fluxing ore was produced. The lead mines in Inyo County were not nearly as productive as in 1923, but prospecting and development were under way at various camps. Development was continued at the Blue Lights, in Orange County, and at several properties in the Julian district. Lead ore was shipped from Santa Catalina Island.

Haley [3] has recently issued a report on the placer gravels of California, which places particular emphasis on the enormous quantity of gravel yet remaining in the Tertiary channels that he believes are workable by hydraulic and drift methods. He outlines a plan

[2] Young, G. J., "Mining in the Mother Lode region of California": Eng. and Min. Jour.-Press, vol. 118, 1924, pp. 64–66.

[3] Haley, Chas. S., Gold Placers of California: Calif. State Min. Bur. Bull. 92, 1923.

for building a series of dams on the Yuba, Bear, and American Rivers, which would not only restrain placer débris but would supply electric power.

The dredging industry was less productive than in 1923. There were two boats less in operation, and near the end of 1924 two boats were destroyed by fire. The operations of the Yuba Consolidated Gold Fields are now largely confined to the development of channels in the Yuba River proper under agreement with the United States Engineers. Late in the year the Yuba Consolidated purchased the properties and dredge of the Marysville Dredging Co. The Natomas Co. of California completed work on its own ground on Feather River but continued work on ground of the American Gold Dredging Co. The 27 dredges in operation during 1924 dug approximately 46,300,000 cubic yards of gravel and made a recovery of $4,315,432 in gold and silver, or an average of 9.32 cents per yard, as compared with 10.25 cents in 1923 and 8.09 cents in 1922. The total production of gold by dredges since the beginning of the industry has been $140,370,455, of which the Feather River field has produced $32,694,438, the Yuba River field $51,843,128, and the American River field $32,318,852.

Mine production of gold, silver, copper, lead, and zinc in California in 1924

County	Ore and tailings treated (short tons)	Deep-mine gold		Placer gold		Total gold	
		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	400,376	130,704.62	$2,701,904	222.72	$4,604	130,927.34	$2,706,508
Butte	4,755	2,111.85	43,656	21,327.27	440,874	23,439.12	484,530
Calaveras	208,461	36,591.86	756,421	4,718.52	97,540	41,310.38	853,961
Del Norte				15.73	325	15.73	325
Eldorado	825	847.86	17,527	516.64	10,680	1,364.50	28,207
Fresno	35	37.22	769	1,558.11	32,209	1,595.33	32,978
Humboldt				61.37	1,269	61.37	1,269
Imperial				12.50	258	12.50	258
Inyo	16,312	954.38	19,729	12.01	248	966.39	19,977
Kern	29,745	7,395.27	152,874	60.87	1,258	7,456.14	154,132
Lassen	160	108.86	2,250			108.86	2,250
Los Angeles	236	36.31	751			36.31	751
Madera	203	118.84	2,457	36.34	751	155.18	3,208
Mariposa	14,813	8,675.08	179,330	133.94	2,769	8,809.02	182,099
Merced				17.18	355	17.18	355
Mono	844	2,401.86	49,651			2,401.86	49,651
Nevada	268,340	135,353.70	2,798,009	1,065.34	22,023	136,419.04	2,820,032
Orange	21						
Placer	4,714	3,176.47	65,663	2,084.66	43,094	5,261.13	108,757
Plumas	560,717	12,291.23	254,082	1,136.27	23,489	13,427.50	277,571
Riverside	88	51.75	1,070			51.75	1,070
Sacramento				55,664.46	1,150,687	55,664.46	1,150,687
San Bernardino	88,812	9,048.37	187,046	25.49	527	9,073.86	187,573
San Diego	230	200.99	4,155	32.64	675	233.63	4,830
Shasta	360,693	11,988.56	247,826	4,779.27	98,796	16,767.83	346,622
Sierra	34,597	37,390.74	772,935	1,274.25	26,341	38,664.99	799,276
Siskiyou	1,070	1,716.36	35,480	1,358.83	28,090	3,075.19	63,570
Stanislaus				9,482.44	196,019	9,482.44	196,019
Trinity	11,266	848.33	17,537	19,579.49	404,744	20,427.82	422,281
Tuolumne	71,800	11,996.13	247,982	387.60	8,012	12,383.73	255,994
Yuba	87	130.57	2,699	96,398.57	1,992,735	96,529.14	1,995,434
	2,019,200	414,177.21	8,561,803	221,962.51	4,588,372	636,139.72	13,150,175
Increase or decrease from 1923	+483,509	+82,497.43	+1,705,373	−93,567.46	−1,934,211	−11,070.03	−228,838

Mine production of gold, silver, copper, lead, and zinc in California in 1924—Con.

County	Deep-mine silver		Placer silver		Total silver	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	27,203	$18,226	37	$25	27,240	$18,251
Butte	1,461	979	1,700	1,139	3,161	2,118
Calaveras	10,782	7,224	357	239	11,139	7,463
Del Norte						
Eldorado	157	105	72	48	229	153
Fresno	15	10	268	180	283	190
Humboldt			10	7	10	7
Imperial			2	1	2	1
Inyo	172,828	115,795	6	4	172,834	115,799
Kern	53,552	35,880	33	22	53,585	35,902
Lassen	65	44			65	44
Los Angeles	8,232	5,515			8,232	5,515
Madera	246	165	16	11	262	176
Mariposa	2,368	1,587	32	21	2,400	1,608
Merced			2	1	2	1
Mono	9,660	6,472			9,660	6,472
Nevada	58,459	39,168	126	84	58,585	39,252
Orange	1,022	685			1,022	685
Placer	548	367	249	167	797	534
Plumas	369,394	247,494	112	75	369,506	247,569
Riverside	867	581			867	581
Sacramento			2,617	1,753	2,617	1,753
San Bernardino	2,285,963	1,531,595	4	3	2,285,967	1,531,598
San Diego	142	95	3	2	145	97
Shasta	512,060	343,080	481	322	512,541	343,402
Sierra	7,597	5,090	161	108	7,758	5,198
Siskiyou	214	143	228	153	442	296
Stanislaus			1,154	773	1,154	773
Trinity	13,995	9,377	2,324	1,557	16,319	10,934
Tuolumne	1,611	1,079	40	27	1,651	1,106
Yuba	2	1	6,656	4,460	6,658	4,461
	3,538,443	2,370,757	16,690	11,182	3,555,133	2,381,939
Decrease from 1923	695	531,336	3,615	5,468	4,310	536,804

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador							$2,724,759
Butte							486,648
Calaveras	4,820,464	$631,481	5,114	$409			1,493,314
Del Norte							325
Eldorado	503	66					28,426
Fresno							33,168
Humboldt							1,276
Imperial							259
Inyo	72,781	9,534	4,612,296	368,984			514,294
Kern	55	7	364	29			190,070
Lassen							2,294
Los Angeles	199	26	54,291	4,343			10,635
Madera	34,467	4,515					7,899
Mariposa							183,707
Merced							356
Mono	5,346	700	30,583	2,447			59,270
Nevada							2,859,284
Orange	61	8	2,673	214			907
Placer							109,291
Plumas	25,557,676	3,348,056					3,873,196
Riverside	8,899	1,166	26,817	2,145			4,962
Sacramento							1,152,440
San Bernardino	1,095	143	31,668	2,533			1,721,847
San Diego							4,927
Shasta	21,056,027	2,758,340			3,060,000	$198,900	3,647,264
Sierra							804,474
Siskiyou							63,866
Stanislaus							196,792
Trinity	549,598	71,997					505,212
Tuolumne							257,100
Yuba							1,999,895
	52,107,171	6,826,039	4,763,806	381,104	3,060,000	198,900	22,938,157
Increase or decrease from 1923	+23,789,412	+2,663,328	−4,785,874	−287,374	+3,060,000	+198,900	+1,809,212

Placer output of gold and silver in California in 1924

County	Dredge		Drift		Hydraulic		Surface		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	
		Fine ounces		*Fine ounces*		*Fine ounces*		*Fine ounces*	
Amador					$3,061	24	$1,543	13	$4,629
Butte	$413,691	1,490	$7,064	42	302	1	19,817	167	442,013
Calaveras	73,277	238	13,653	68			10,610	51	97,779
Del Norte							325		325
Eldorado			1,422	2			9,258	70	10,728
Fresno							32,209	268	32,389
Humboldt					573	6	696	4	1,276
Imperial							258	2	259
Inyo							248	6	252
Kern							1,258	33	1,280
Madera							751	16	762
Mariposa			1,573	24			1,196	8	2,790
Merced							355	2	356
Nevada			16,508	99	4,290	17	1,225	10	22,107
Placer	23,895	140	14,557	82			4,642	27	43,261
Plumas			13,684	57	2,952	13	6,853	42	23,564
Sacramento	1,145,075	2,587					5,612	30	1,152,440
San Bernardino							527	4	530
San Diego							675	3	677
Shasta	91,632	433	199	1			6,965	47	99,118
Sierra			18,015	130	6,199	21	2,127	10	26,449
Siskiyou					21,969	172	6,121	56	28,243
Stanislaus	192,232	1,134					3,787	20	196,792
Trinity	381,550	2,155	668	5	20,849	155	1,677	9	406,301
Tuolumne			7,552	37			460	3	8,039
Yuba	1,984,169	6,616	3,673	13			4,893	27	1,997,195
	4,305,521	14,793	98,568	560	60,195	409	124,088	928	4,599,554
Decrease from 1923	1,760,214	2,776	86,203	395	51,633	217	36,161	227	1,939,679

REVIEW BY COUNTIES

AMADOR COUNTY

At Amador City the Amador Queen was worked by lessees, but the Fremont-Gover was closed most of the year.

At the Kennedy mine, at Jackson, the largest gold producer in the county, the shaft was sunk an additional 150 feet, making it 4,462 feet deep. According to report an excellent vein was opened at the lowest level. The Argonaut doubled its 1923 output; the incline shaft was deepened 350 feet and is now 5,220 feet long. Most of the gold was saved at the 60-stamp mill, but concentrates and tailings were retreated at the cyanide plant of the Amador Metals Co. The Moore shaft was deepened 400 feet. The mill ran at half capacity the first half of the year but at full capacity after September. The Sunset mine was productive. At Middle Bar and Ione several ounces of gold were recovered from placers, and the Mammoth mine was worked by lessees. The Haverly quartz mine at Pine Grove was under development throughout the year, and the Ludekens hydraulic had water for a four months' run.

The Plymouth at Plymouth treated less ore than in 1923, partly because of water shortage. Extensive development was started, and by fall the 4,150-foot level was reported in a good body of milling ore. The Central Eureka at Sutter Creek increased its production, using 40 stamps, and shipped concentrates to the smelter. This company acquired the Hetty Green mine and started developing that famous producer from the 4,100-foot level of the Central Eureka shaft.

At Volcano the Grillo Bros. worked the Elephant hydraulic under lease, the Pioneer hydraulic was worked by R. Moar, and the Defender quartz property was worked under lease.

BUTTE COUNTY

The production of gold and silver in Butte County in 1924 was practically the same as in 1923. The largest production was from the three dredges near Oroville and the one boat near Chico on Butte Creek. Ore from surface workings on the Banner mine, near Oroville, yielded some gold. The Surcease mine, near Yankee Hill, was operated throughout the year by Latham & Goble, and several thousand tons of gold ore were cyanided after the mill was started in June. The Triumph gold quartz mine, near Feather Falls, was worked under lease by S. A. Williams the last half of the year. Drift operations at the Kelly Hill and Lucky John, near Magalia, and the Dix Extension and Oro Fino, near Nimshew, resulted in the saving of $7,092 in bullion. At the Robinson drift, near Forest Ranch, and the Mammoth drift, near Magalia, work on drain tunnels continued. During the year the properties of the American Gold Dredging Co. at Oroville were sold to the Pacific Gas & Electric Co., and the one remaining dredge continued operations under the new management. The ground owned by the Natomas Co. of California was worked out in 1924. The No. 3 dredge of this company was closed down January 17, 1925, and the No. 1 boat will have a few months' work in 1925 on land of the American Gold Dredging Co.

CALAVERAS COUNTY

That the total value of metals produced in Calaveras County did not decrease was due largely to the renewed, large-scale activity of the Calaveras Copper Co., for the production of gold declined $351,823. The chief placer-gold producers were the Isabel dredge at Jenny Lind, the Camanche dredge near Camanche, the Victor drift mine near Altaville, the Last Chance drift at Vallicita, and the Pacific Gravel Co. at Valley Springs. There was practically no water for hydraulic mining, and surface work at placers was much restricted. The McSorley drift mine near Mokelumne Hill continued development.

The Calaveras Copper Co. at Copperopolis milled over 62,500 tons of ore at its 400-ton flotation plant and smelted concentrates and 2,600 tons of ore in the newly installed oil-fired reverberatory. The production in 1924 was over three times as great as in 1923. The Finnegan mine at Carson Hill was productive. The Carson Hill Gold Mines continued development and production on a large scale. The Red Top mine at Murphy was productive, and the Ford mine at San Andreas, worked by the Apex Mining Co., continued development and shipped some concentrates. A number of mines near Westpoint were productive, the chief producers being the Black Wonder, Columbus, Excelsior, Forest Creek, Gold Crown, and Lone Star. The Gold Knoll mine at Felix was under development throughout the year. The Washington mine, near Sheepranch, was in operation, but the other mines in that camp were idle. At the Boston mine, near Mokelumne Hill, 500 feet of development work was done.

COLUSA COUNTY

The Western Mining & Development Co. evidently abandoned its attempt to reopen the Siereci mine near Wilbur Springs.

DEL NORTE COUNTY

A small production of gold from placers near Crescent City was recovered during 1924. No ore was shipped from mines in the county.

ELDORADO COUNTY

Placer gold was recovered by a number of small operations near El Dorado, Fairplay, Georgetown, Grizzly Flat, Latrobe, Michigan Bar, and Placerville in 1924. The Barbara Mining Co. took over the Rocky Bar placer, near Fairplay, and installed an orange-peel bucket for digging. Husler & Wachter, operating the mine formerly worked by the Grit Consolidated on the Bucknam properties near Georgetown, milled about 300 tons of ore and made a good clean-up. The Hines Gilbert Gold Mining Co. at Greenwood was the largest producer in the county, though the mill could be run only half the year on account of water shortage. The greater part of the gold from deep mines was found in relatively small pockets at various points along the Mother Lode. The Sliger quartz mine at Spanish Dry Diggings was further developed, and the erection of a mill is reported to be considered. The Guildford mine at Poverty Point was reopened by Placerville people.

FRESNO COUNTY

The chief gold producers in Fresno County are the Grant Rock & Gravel Co. and the Service Rock Co., whose plants for washing and crushing gravel are at Friant. The gold is saved as a by-product. About 50 ounces of gold was saved at small surface placer operations near Auberry, Sanger, and Friant. No regular mining was done at Fresno County deep mines in 1924, but prospecting was under way at the Ragsdale and Dunlap properties near Sanger.

HUMBOLDT COUNTY

Bullion produced in Humboldt County came from hydraulic operations near Orleans, mainly at the Orcutt mine, and from beach mines, whose product was sold through Arcata and Eureka. At the Salstrom placer, between Camp and Crawford Creeks, a new 3 by 5 foot flume was built in preparation for work in 1925.

IMPERIAL COUNTY

The placer gold produced in Imperial County was from dry washing in the Hedges district. No deep mines were in operation.

INYO COUNTY

The mines of Inyo County were not as active in 1924 as in 1923, and production of lead ore decreased 57 per cent. At Big Pine the Cometti mine was under development, and bullion was saved from test runs. The Wilshire mine, near Bishop, was under lease, but no development of consequence was accomplished and no production

made. The Big Horn mine at Ballarat, 30 miles from Trona, shipped lead ore until May; after that a road to obviate a 4-mile pack was built and shipments were discontinued for the balance of the year.

At Keeler the Estelle mines were operated until May by the Estelle Mining Co., and after that by the Estelle Mines Corporation. Both operators shipped crude lead ore. A three-compartment raise from the Dellaphene tunnel was started on the San Felipe vein for the purpose of prospecting and developing additional ore. The Morning Star mine was worked under lease by Harry Hilderman. The properties of the Santa Rosa Lead Co. were operated in a small way by various lessees. The Cerro Gordo, worked under lease by the Natural Soda Products Co., shipped lead ore and limestone. The Darwin Silver mines at Darwin were not operated to capacity, though the 125-ton concentrator handled a considerable tonnage of lead ore. Late in the year several lots of lead ore were shipped from subleases. The Tecopa Consolidated continued as the largest producer of lead ore in Inyo County, shipping 500 tons of carbonate ore, carrying more than 20 per cent lead. The Ashford mine, out from Shoshone, was further developed, and several leasing companies made shipments of lead ore from the Carbonate, Montezuma, Lead group, and Crescent prospects tributary to Trona.

KERN COUNTY

The Zenda mine, out from Caliente, continued operations, but the cyanide plant was not in operation during the latter part of the year, pending further development of the mine. The Royal Flush and Ferris mines were producers, and prospecting in the Barrossa Mountain section was successful. The R. A. 4 (No. 1 and 2) property milled 200 tons of ore. The Steamboat group, near Bodfish, was productive. The Kern Mining Co. at Kernville did some milling. A small amount of placer gold was recovered along Kern River.

Siliceous gold ore was shipped to smelters from the Karma, Ajax, Elephant, and Yellow Dog Extension mines, near Mojave. The mill at the Bessie Claire ran a short time, and ore from the Yellow Dog mine was milled at the Tropico plant at Rosamond.

At Randsburg the King Solomon mines were operated by a new company under R. A. Drain, superintendent. The Yellow Aster continued production under the leasing system. Several lots of ore from small workings in the Stringer district were milled at the Black Hawk mill. Nothing further was done at the Phoenix mine. About 20 ounces of gold was recovered by dry washing near Randsburg. The Tropico mine at Rosamond was operated, and the 10-stamp amalgamation and cyanidation plant ran about half the year.

LASSEN COUNTY

The Juniper mine at Hayden Hill and the Last Hope at Merrillville were in operation during 1924. A little prospecting was done on other properties at Hayden Hill and near Doyle.

LOS ANGELES COUNTY

No mines in the Camp Baldy district reported production during 1924. In July the mill at the Monte Cristo mine near Acton made a test run. The Gold Dollar mine in the San Gabriel Mountains was worked until July. Lead ore was shipped from Santa Catalina Island.

MADERA COUNTY

A milling was made at the Texas Flat mine near Coarsegold during the last half of 1924. The Hornets Nest, Hanover, White Rock, and Cranmer mines in the Hildreth district near O'Neals were productive. Cement copper and some copper ore were shipped from the Daulton district.

MARIPOSA COUNTY

The French mine at Bagby was reopened and some ore milled before a forced shutdown due to lack of water. The Original mine at Clearinghouse was the largest producer in the county and was active throughout the year. The Argo, Contention, and Flyaway at Coulterville were developed and produced some gold. The Schoolhouse mine at Hornitos was in operation; bullion was shipped from the Ruth Pierce mine and by several pocket hunters. Gans and Johnson had a lease on the Feliciana mine at Mariposa; small pockets were mined at the B & B, Mack-Kell, and Rex mines near that place. At Whitlock (Mount Bullion district) the Deltz and Spread Eagle mines were reopened by lessees. The Princeton mine at Mount Bullion was worked for eight months, a considerable amount of development was done, and several hundred tons of ore were milled. The Jumper mine at Bagby was sinking a new shaft. The Texas Hill at Coulterville was idle, and part of the flume which supplied power was destroyed by a forest fire. The placer output of the county came from small operations near Bagby, Kinsley, and Mariposa.

MERCED COUNTY

A little placer mining on Merced River near Merced Falls was recorded in 1924.

MODOC COUNTY

None of the properties in the High Grade-Fort Bidwell section were operated. The Hess mine at Adin was idle.

MONO COUNTY

There was considerable activity in the Blind Springs Hill district out from Benton. The Comanche Mining & Reduction Co. continued development of the Diana and Comanche veins and shipped lead ore. Lessees on the Bismark and several other properties near by also produced some lead and copper ore during the year. The Bodie district was idle, though a small amount of bullion was shipped from the Standard and from the Bodie tailings accumulated at Fletcher, Nev. The Visalia Masonic Mining Co. continued work at the Chemung mine at Masonic until April, when its lease expired; some gold was produced by sublessees during the balance of the year. A 100-ton cyanide plant was under construction by the Mono Mining Co. in Silverado Canyon west of Sweetwater, Nev. Old tailings on the Contention claims in Fryingpan Creek were cyanided by H. W. Hull. The May Lundy in the Homer district was not operated, though some rehabilitation was under way.

MONTEREY COUNTY

Development continued at the New York mine. No other properties in the Gorda district did more than assessment work.

NEVADA COUNTY

At Edwards Bridge C. C. Bennett used a drag-line scraper on the river gravels with disappointing results. The Liberty Hill hydraulic mine had water for a 30-day run; the You Bet hydraulic, operated under lease by Sidney B. Wood, was able to run only a short while. Drift mining at Smartsville and North Bloomfield yielded about 300 ounces of bullion, but the largest placer operation in the county was the Quaker Hill drift at You Bet.

At Graniteville the Gaston Gold Mining Co. operated the 70-ton stamp mill at the Gambrinus, and the Ancho made a small production; the Republic-National mine was operated throughout the year, and a cyanide mill was built to treat the concentrates.

At Grass Valley[4] the Empire and North Star mines were, as usual, the largest producers. The Idaho Maryland was operated throughout the year; for awhile it had the Brunswick under option and kept the shaft unwatered. A considerable output was made at the Golden Center, and the Alaska and Randolph mines were productive. The annual report of the North Star Mines Co. states that operations during 1924 were at a loss. The mill treated 109,200 tons of ore that averaged $7.98 a ton. Operating costs were $6.91 and development costs $1.69 a ton, indicating a loss of $0.62 a ton treated. Sinking of the North Star vertical shaft an additional 2,000 feet and of two winzes and the driving of 2,500 feet of levels to explore and develop the ground below the present working levels were authorized.

The Empire Mines Co. acquired the adjoining Sultana ground, including the Orleans, Prescott, Heuston Hill, and Green Mountain claims. The Dull or Newtown mine was bonded by interests closely associated with the Argonaut mine. The Eagle Bird and Twin Sisters mines at Washington were productive.

ORANGE COUNTY

The Silverado or Blue Lights mine near Anaheim was under extensive development and it was reported that a faulted part of the vein had been recovered.

PLACER COUNTY

The Colfax Dredging Co. continued work with its dredge on the American River near Auburn. Various drift mines near Foresthill were worked by lessees, none of the larger holdings being operated by the owners. The principal production of the district came from the Elaine and Georgia Hill ground. At Iowa Hill some of the drift mines were worked under lease. The Glenn drift mine at Bald Mountain, near Michigan Bluff, was operated for nine months and the Home Ticket drift for six months. A considerable quantity of gold was handled by banks and storekeepers at Auburn and Colfax. The origin of this gold is uncertain but has been credited to Placer County mines.

The Big Oak Tree and Rising Star quartz mines near Colfax were worked part of the year by their owners, but after June by the California Premier Mines Corporation. The American Bar Quartz

[4] Howe, E., Gold ores of the Grass Valley region: Econ. Geology, vol. 19, 1924, pp. 595–623.

Mining Co. at Michigan Bluff worked all the year and reequipped the mill with heavy stamps. Pockets were extracted at the Annie Laurie, Adventure, Red Jacket, and Johnny Rafael properties.

PLUMAS COUNTY

The largest producing placer mine in Plumas County was the Marguerite drift, out from La Porte, though several small hydraulic mines in the district were operated. The Little Grizzly hydraulic near Genesee had water for only a very short run. The Sunnyside and Yankee Bar drift mines near Seneca were operated. The Twelve Mile Bar and French Ravine sluice properties near Twain were operated, and a number of snipers were at work on Spanish Creek, Indian Creek, and Feather River.

The Engels Copper Co. curtailed output during the first part of the year during the completion of the No. 10 tunnel of the Engels mine. Additions were made to the flotation plant at the Superior mill, and considerable development was accomplished at the Superior mine. During the year the production of the Engels Copper Co. was 12,870,111 pounds of copper, 150,427 ounces of silver, and 2,593 ounces of gold, recovered from 350,445 tons of ore milled. In 1924, recovery at the Superior mill was 89 per cent. The annual report of the company says that operating costs for copper produced in 1924, with gold and silver credited, were 11.30 cents a pound, as compared with 11.35 cents a pound in 1923. During the year a total of 6,480 feet of development was completed at the Engels mine, about one-third of which was in the No. 10 tunnel, and 4,657 feet of work in the Superior mine, most of which was on the No. 1 and No. 2 levels. Ore reserves carrying 2 per cent or more in copper are given as 2,849,397 tons at the end of 1924, two-thirds of which are at the Engels mine and one-third at the Superior. Less than a million tons of the total is estimated as probable ore.

The Walker mine, north of Spring Garden, operated at full capacity. The new flotation mill treated 205,903 tons of ore, averaging 3.27 per cent copper, and made a 96 per cent recovery. The output of the mine was 12,659,429 pounds of copper, 217,764 ounces of silver, and 8,216.40 ounces of gold, according to the annual report of the Anaconda Copper Mining Co.

The Jamison mine at Johnsville was worked until September by lessees; little development work was done, but several hundred tons of ore was milled. This was the largest deep-gold mine in operation in the county. The Gold Leaf Consolidated mine near Spring Garden built a small cyanide mill to handle tailings from the Lane mill. A few tons of copper ore was shipped from mines near Taylorsville, and the Standard mines near Greenville were developed further, but no production was reported.

RIVERSIDE COUNTY

The Meleta mine out from Mecca shipped lead ore, and the Overton mines near Vidal some copper ore during the year. It is reported that the Overton Mining Co. will erect a 50-ton concentrating mill.

SACRAMENTO COUNTY

The Natomas Co. of California operated six dredges near Natoma during 1924. The No. 10 dredge finished its ground in June; it was dismantled, rebuilt at a new location, and began digging again early in 1925. The output of gold by Sacramento County dredges was considerably less, because for half the year only five boats were in operation. The annual report of the company says that the gross return of the gravels worked at Natoma was 9.66 cents a yard, 0.20 cent less than in 1923, but operating costs decreased 0.07 cent a yard also. Several hundred dollars in gold was obtained by small operators in the Blue Ravine diggings, 3 miles above Folsom, and at various points along the American River between Folsom and Sacramento.

SAN BERNARDINO COUNTY

In the Calico district the Olympus Gold Mines Co. rebuilt its water system, erected a 50-ton Denver quartz mill, and made a test run. The Mulcahy brothers worked the Homestake, Silver King, and Red Jacket mines. Weeks [5] has recently described the geology of the district; he concludes that the rich silver veins of the Tertiary volcanic rocks that were so productive between 1883 and 1890 hold enough promise of ore bodies at depth to warrant further development.

There was very little activity in the Cima district, though at a few mines some development was done.

In the Rand district tributary to Osdick the California Rand Silver was the most important mining operation. The mine produced 86,519 tons of ore, practically all of which was milled; the flotation concentrates were shipped to the smelter. Colman [6] has described milling at the California Rand. The milling costs were $2 a ton, of which 60 cents was for water; recovery 84 per cent of the gold and 97 per cent of the silver. The annual report of the company for the year ended September 30, 1924, shows that the gross value of the product was $1,454,106.85, the total gross production of the mine since its discovery $10,384,537.74, and total dividends $2,885,966.31, of which $486,400 was paid in 1924. Late in 1924 eastern capitalists had the property examined but did not exercise the option to purchase. The Black Hawk mine was operated on company account until May and after that by lessees. The Black Hawk mill treated custom ore from several mines in San Bernardino and Kern Counties. Lead ore produced at the Hillside mine in the Shadow Mountains was shipped from Valjean.

SAN DIEGO COUNTY

The Golden Chariot mine at Julian was developed further, and a little ore was milled. The Lone Pine Mining & Development Co. operated the North Hubbard and Ready Relief groups at Julian; ore was milled in the 50-ton Denver quartz mill.

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[5] Weeks, F. B., "Possibilities of the Calico mining district": Eng. and Min. Jour.-Press, vol. 119, 1924, pp. 757–762.

[6] Colman, M. W., "Metallurgical history of the California Rand": Eng. and Min. Jour.-Press, vol. 120, 1925, pp. 175–181.

SHASTA COUNTY

The placer output of Shasta County declined over $200,000 because the American Gold Dredging Co. dug out its ground on February 11, 1924, and the No. 2 Gardella dredge was destroyed by fire late in the year.

In the French Gulch district the Milkmaid, Scorpion, Niagara, and Summit Gulch mines were productive. The mines and smelter of the United States Smelting, Refining & Mining Co. at Kennett were in continuous operation and made the largest recovery of copper recorded in the county for a number of years. Ore came from the Balaklala, Mammoth, Keystone, and Sutro mines. In August a forest fire destroyed the tram line to the Keystone and Balaklala mines, but the line was repaired before the end of November. The smelter also handled a large tonnage of siliceous fluxing ore from various Shasta County mines, the Reid mine being one of the largest contributors. The copper mines of the Mountain Copper Co. were not worked, but pyritic ore was shipped from the Hornet mine at Keswick. The last Chance and Gold Dollar mines near Shasta were productive. At Bully Hill the California Zinc Co. began production from the Rising Star mine in October and rebuilt the zinc oxide smelter, which was blown in late in November. The California Zinc Co. acquired the Afterthought mine near Ingot and began planning the 8-mile tram to bring ore from that mine to the mill and smelter at Bully Hill.

SIERRA COUNTY

The Diamond Peak Development Co. worked the Mugwump drift at Forest, formerly known as the Young America drift mine. The Lucky Dog drift was operated until July. A little placer gold was recovered at the Maple Grove drift at Alleghany, and some small hydraulic operations were carried on at Brandy City. In the Pike district out from Camptonville the Depot Hill and Indian Hill hydraulic mines had water for only short runs. The Scales Syndicate continued development at Scales, but had little water. The Table Rock drift mine at Howland Flat was under development.

The Sixteen to One mine at Alleghany was by far the most important producer in the county, although its output was lower than in 1923. The Tightner mine, adjoining the Sixteen to One, was acquired by the latter company in February (1924). The El Dorado, El Dorado Extension, and Terrible or Bullion mines were bonded by the Alleghany-El Dorado Gold Mining Co. At the Irelan mines the shaft was deepened 100 feet and drifts on the 200-foot level were extended. Development of the Morning Glory mine was continued. The Oriental mine was the second largest producer in the Alleghany district. The Plumbago mine was worked until March by the Ante Up Mining Co. and after a short shutdown was further developed by the North Star Mines Co., which was also prospecting and developing the Rainbow mine. The Kanaka was bonded to the Natural Resources Development Co.

At Downieville the Bessler mine was optioned to the Golden Key Mining Co., and the Oxford was under development. The Kate

Hardy at Forest was worked throughout the year. The Brush Creek, west of Forest, was operated by the Ante Up Mining Co. until May and later by the French Gulch Mining Co.

The Four Hills mine, out from Johnsville, continued production for part of the year. At Sierra City the Primrose was worked, and the Young America quartz mine was productive under the direction of lessees.

SISKIYOU COUNTY

Although some 21 hydraulic mines and 13 surface placers in Siskiyou County were productive in 1924, water was so low that few made a clean-up of more than 20 to 30 ounces for the year. The largest production came from hydraulic mines at Forks of Salmon, Fort Jones, at Happy Camp, Sawyers Bar, and Somesbar. The output of quartz mines was small, though a rich body of quartz was taken out at the Independence mine, Happy Camp, by H. C. Cutting. The Homestake, Gilta, and Gold Ball quartz mines near Etna Mills were operated, and development work was done at the Victory mine near Snowden. The properties near Yreka were developed, and a small milling was made at the Mount Vernon mine.

STANISLAUS COUNTY

The La Grange dredge worked the entire year on Tuolumne River near La Grange. Gold was saved as a by-product at the gravel-washing plant of the Atlas Rock Co. at Oakdale and by various prospectors near Oakdale, Knights Ferry, and La Grange. No deep mines were operated.

TRINITY COUNTY

The Lewiston, Trinity, and Gardella dredges near Lewiston and the Estabrook dredge near Trinity Center were in operation throughout the year. The Gardella dredge was destroyed by fire late in December. The most productive hydraulic mines were the McAtee Bar, Steiners Flat, Bablew, and Nugget Bar, though gold was saved by hydraulic mining at Big Bar, Carrville, Denny, and near Weaverville. The Island Mountain Copper Co., in the extreme southwest corner of the county, shipped copper sulphide ore to Tacoma. A few tons of siliceous gold ore were milled at the Black Bonanza and Packer mines on Coffee Creek, and the Blue Jay, Gold Hill, and Five Pines mines in Eastman Gulch near Lewiston were worked by lessees.

TUOLUMNE COUNTY

Production of placer gold in Tuolumne County came largely from the Springfield, Saratoga, Morris, and Tennessee drift mines under Table Mountain near Sonora, although some placer gold was obtained at the Menke and Keith drift mines near Chinese Camp and on Mormon Creek near Tuttletown.

At Big Oak Flat small pockets were found at the Arizona, Brinkham, Eureka, and Silken mines. At the Clio mine the Clio Vindicator Mines (Inc.) erected a 50-ton cyanide plant, sunk the incline

shaft 150 feet more, and ran the mill from August to December. The Fifty Five mine, out from Chinese Camp, a new discovery in 1924, shipped siliceous gold ore. Nearly 300 ounces of gold was taken from pockets at the Fox and Hudson, Ham and Birney, and Star mines, at Columbia. The Casa Madera, near Confidence, continued development and erected a 40-ton mill. At the Norwegian mine, out from Jamestown, Nelson & Gillis made a good recovery in 1924. The Heslop Mining & Milling Co. near Jamestown was reported in operation part of the year. The Rawhide mine was bonded to the Marne-California Mining Co. in November. The Eagle Shawmut was the largest gold producer in the county; the cyaniding of concentrates at this mine was discontinued in 1924 and all concentrates shipped to smelters.

YUBA COUNTY

The five dredges of the Yuba Consolidated Gold Fields and one boat of the Marysville Dredging Co. produced practically all the gold mined in Yuba County in 1924. There was a little production near Camptonville and Dobbins by small operators, and at Smartville a small output was made at drift mines. It has been reported that a dredge will be built in Garden Valley below Camptonville. The Good Title quartz mine at Indian Ranch near Dobbins was worked by T. J. Williams, and the Lone Pine Tree mine southwest of Smartville was unwatered for examination.

GOLD, SILVER, COPPER, AND LEAD IN OREGON

(MINE REPORT)

By James M. Hill [1]

PRODUCTION

The total value of the gold, silver, copper, and lead produced in Oregon in 1924 was 12 per cent less than the corresponding value in 1923. The value of gold increased 11 per cent, but the quantity of silver decreased 60 per cent, copper 40 per cent, and lead 98 per cent, as compared with 1923. The 43 deep mines reporting in 1924 produced 41 per cent of the gold and 94 per cent of the silver credited to the State, as compared with 44 per cent of the gold and 98 per cent of the silver produced by 55 deep mines in 1923.

The 71 placer mines operated in 1924 produced 59 per cent of the gold and 6 per cent of the silver output, as compared with 56 per cent of the gold and 2 per cent of the silver saved by the 151 placer mines operated in 1923. In 1924 three dredges produced 90 per cent of the placer gold. The production by hydraulic and surface mining decreased because drought caused a scarcity of water.

Mine production of gold, silver, copper, and lead in Oregon, 1920–1924

Year	Number of producing mines	Ore	Gold [a]	Silver [a]	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1920	67	82,156	$1,017,490	82,743	2,355,276	----------	$1,541,051
1921	107	40,333	882,034	42,120	174,300	----------	946,639
1922	170	27,522	531,568	151,812	1,046,525	76,976	818,894
1923	206	50,385	498,608	96,322	1,263,476	27,523	767,590
1924	114	44,842	551,842	38,103	768,395	513	678,072

[a] Includes placer production.

Placer production of gold and silver in Oregon, 1920–1924

Year	Dredge		Hydraulic and drift		Surface		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	
		Fine ounces		*Fine ounces*		*Fine ounces*	
1920	$358,864	3,939	$88,604	889	$3,649	25	$456,407
1921	381,960	3,617	88,312	577	8,461	97	483,024
1922	269,994	2,452	58,537	393	17,606	166	349,148
1923	224,117	1,649	39,408	334	13,245	79	278,461
1924	291,557	2,024	21,872	161	12,153	94	327,109

[1] Miss Helen M. Gaylord, of the Bureau of Mines, assisted in the preparation of this report.

ORE

In 1924 the deep mines produced 44,842 tons of ore, a decrease of 11 per cent as compared with 1923. The decrease was in the production of silver ore, of which 156 tons was mined in 1924 as compared with 1,973 tons in 1923, and of copper ore, of which 4,109 tons less was mined than in 1923. The quantity of dry gold ore mined in 1924 was 383 tons greater than in 1923.

The copper ore produced in the State in 1924 came from mines in Baker and Marion Counties, silver ore from Baker County, and the dry gold ore from mines in eight counties, as shown in the second table below.

Ore and metals produced in Oregon in 1924

Source	Ore		Gold		Silver	
	Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	29,855	66.58	8,941.37	33.49	18,352	48.16
Dry silver ore	156	.35	2.20	.01	4,778	12.54
Copper ore	14,831	33.07	2,001.75	7.50	12,694	33.32
Total deep mines	44,842	100.00	10,945.32	41.00	35,824	94.02
Total placers			15,750.04	59.00	2,279	5.98
	44,842	100.00	26,695.36	100.00	38,103	100.00
Increase or decrease from 1923	−5,543		+2,604.22		−58,219	

Source	Copper		Lead	
	Pounds	Per cent	Pounds	Per cent
Dry gold ore	1,143	0.15	513	100.00
Dry silver ore	2,543	.33		
Copper ore	764,709	99.52		
	768,395	100.00	513	100.00
Decrease from 1923	515,081		27,010	

Dry gold ore sold or treated in Oregon in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	22,323	4,865.16	7,703	108	
Curry	271	372.26	44		
Douglas	17	54.55	81	88	
Grant	6,137	2,600.19	10,274	947	513
Jackson	98	163.07	28		
Josephine	309	447.57	71		
Lane	100	97.06	46		
Malheur	600	341.51	105		
	29,855	8,941.37	18,352	1,143	513

The dry gold ore mined in 1924 contained 33 per cent of all the gold produced in the State and 82 per cent of the gold derived from deep mining. Its silver content was 48 per cent of the State total and 51 per cent of the silver of all deep mines. The copper content was negligible. The lead output of the State came from ore classed as dry and siliceous. The silver ore mined carried almost no gold and little copper. The copper ore produced constituted 33 per cent of the total ore mined and contained over 7 per cent of the gold, 33 per cent of the silver, and more than 99 per cent of the copper produced.

Value of metals from ore sold or treated in Oregon, 1923–24

Class of ore	Ore (short tons)	Total value		Average value per ton	
		In gold and silver	In all metals	In gold and silver	In all metals
1923					
Dry gold	29,472	$176,087	$176,632	$5.97	$5.99
Dry silver	1,973	38,208	42,754	19.37	21.67
Copper	18,940	84,236	269,743	4.45	14.24
	50,385	298,531	489,129	5.92	9.71
1924					
Dry gold	29,855	197,131	197,322	6.60	6.61
Dry silver	156	3,246	3,579	20.81	22.94
Copper	14,831	49,885	150,062	3.36	10.12
	44,842	250,262	350,963	5.58	7.83

GOLD

The mine production of gold in Oregon in 1924 was 26,695.36 ounces, valued at $551.842, an increase of 2,604.22 ounces and of $53,834 over 1923. Baker County still maintained its lead as a gold producer, supplying 59 per cent of the State total, and increased its production by 1,637.45 ounces. Grant County mines produced 648.75 ounces more gold than in 1923, but the mines in Josephine and Jackson Counties fell off 140.24 ounces in gold production.

The placer production of gold in 1924 was 15,750.04 ounces, valued at $325,582, which was 4,804.72 ounces greater than the yield from deep mines. Baker and Grant Counties contributed 92 per cent of the total placer-gold output of the State because of the dredges in those counties. The value of gold produced by dredges was 90 per cent of the value of all gold won by placer mining and 53 per cent of the value of all the gold produced in the State.

Twelve of the 114 mining operations reporting in 1924 accounted for 89 per cent of the total gold output. Of these 3 were dredges, 1 was a hydraulic mine, and 8 were deep mines, of which 7 produced dry gold ore and 1 copper ore. Only 4 mines produced more than 4,000 ounces each, and these mines produced 69 per cent of the gold produced in the State in 1924. Three of these were dredges and 1 a producer of dry gold ore.

Gold and silver produced at placer mines in Oregon in 1924, by counties, in fine ounces

County	Dredge		Hydraulic and drift		Sluice		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	
Baker	[a]14,104.08	[a]2,024	137.34	30	119.05	18	$183,267
Coos			12.86	1	22.98	2	743
Crook			3.08	2			65
Curry					12.96	3	270
Douglas			74.30	10			1,543
Grant	[a]	[a]	44.90	8	91.93	15	117,821
Jackson			348.94	63	54.72	10	8,393
Josephine			373.39	39	273.70	42	13,431
Linn					12.58	4	263
Malheur			56.32	7			1,169
Wheeler			6.91	1			144
	14,104.08	2,024	1,058.04	161	587.92	94	327,109

[a] Dredge output in Baker and Grant Counties combined to avoid disclosure of output of individual companies.

SILVER

The silver produced in Oregon in 1924 amounted to 38,103 ounces, a decrease of 60 per cent from 1923. The greatest contributor to the silver output was the Homestead Iron Dyke, a copper mine. The Bay Horse mine was under development, and little ore was shipped. Placer mines produced 2,279 ounces of silver, nearly all of which came from dredges in Baker and Grant Counties. Four deep mines (one producing silver ore, one copper ore, and two gold ore) and three dredges yielded 78 per cent of the total output of silver. The four deep mines yielded more than 72 per cent of the total silver and 77 per cent of the silver produced by deep mines. The three dredges produced 89 per cent of the silver produced by placer mines and more than 5 per cent of the total silver output of the State.

COPPER

The output of copper from Oregon mines in 1924 was 768,395 pounds, valued at $100,660, a decrease of 515,081 pounds and $88,011 as compared with 1923. Baker County produced 99 per cent of the copper mined in the State.

LEAD

Lead was recovered as a by-product from ores mined in Grant County chiefly for their gold content. The production in 1924 was 513 pounds, valued at $41, a decrease of 27,010 pounds and $1,886 as compared with 1923.

METALLURGIC INDUSTRY

Metallurgic recovery of metals in Oregon, 1923–24

Method of recovery	Material treated	Gold	Silver	Copper	Lead
1923	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	1,552	1,150.50	796	----------	----------
Cyanidation:					
Crude ore	25,454	4,736.29	13,793	----------	----------
Tailings	29	114.91	1	----------	----------
Smelting:					
Ore	3,645	1,181.30	56,048	107,333	27,368
Concentrates	5,450	3,519.39	23,622	1,176,143	155
	----------	10,702.39	94,260	1,283,476	27,523
1924					
Amalgamation	1,743	1,925.84	401	----------	----------
Cyanidation: Ore	21,435	4,285.60	6,887	----------	----------
Smelting:					
Ore	431	557.13	8,148	10,845	513
Concentrates	4,027	4,176.75	20,388	757,550	----------
	----------	10,945.32	35,824	768,395	513

Of the ore mined 23,178 tons was treated in gold mills and yielded 57 per cent of the gold and 20 per cent of the silver from deep mines in the State. The reports from amalgamation mills do not give data on the consumption of quicksilver.

Dry gold ore treated at mills equipped for concentration amounted to 6,487 tons, from which were produced 609 tons of concentrates

that contained 2,175 ounces of gold, 7,827 ounces of silver, and 108 pounds of copper. Over 90 per cent of this ore was mined in Grant County and about 10 per cent in Baker County. Of the 14,831 tons of copper ore mined in the State 14,746 tons mined in Baker County was concentrated into 3,418 tons of concentrates, which contained 2,002 ounces of gold, 12,561 ounces of silver, and 757,442 pounds of copper.

Gold and silver produced at amalgamation and cyanidation mills in Oregon in 1924

County	Ore to gold and silver mills	Gold in bullion	Silver in bullion
	Short tons	*Fine ounces*	*Fine ounces*
Baker	21,723	4,558.46	6,948
Curry	271	372.26	44
Grant	77	231.51	46
Jackson	98	163.07	28
Josephine	309	447.57	71
Lane	100	97.06	46
Malheur	600	341.51	105
	23,178	6,211.44	7,288

Metals produced from Oregon concentrates in 1924

County	Ore to concentrating mills	Concentrates	Gold	Silver	Copper
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
Baker	15,346	3,478	2,308.45	13,316	757,550
Grant	5,887	549	1,868.30	7,072	----------
	21,233	4,027	4,176.75	20,388	757,550

Of the ore shipped direct to smelters from Oregon mines during the year, 190 tons was dry gold ore, which contained 554.93 ounces of gold, 3,237 ounces of silver, 1,035 pounds of copper, and 513 pounds of lead. The dry gold ore shipped to smelters came from Grant and Douglas Counties. From the 156 tons of dry silver ore shipped direct to smelters from Baker County mines the recovery was 2.20 ounces of gold, 4,778 ounces of silver, and 2,543 pounds of copper. The 85 tons of copper ore sent direct to smelters came from Baker and Marion Counties; it contained no gold, 133 ounces of silver, and 7,267 pounds of copper.

Metals produced from Oregon crude ores shipped to smelters in 1924

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	170	2.20	4,806	3,591	----------
Douglas	17	54.55	81	88	----------
Grant	173	500.38	3,156	947	513
Marion	71	----------	105	6,219	----------
	431	557.13	8,148	10,845	513

MINING INDUSTRY

Mine production of gold, silver, copper, and lead in Oregon in 1924

County	Ore (short tons)	Quartz gold		Placer gold		Total gold	
		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	37,239	6,869.11	$141,997	8,816.60	$182,255	15,685.71	$324,252
Coos				35.84	741	35.84	741
Crook				3.08	64	3.08	64
Curry	271	372.26	7,695	12.96	268	385.22	7,963
Douglas	17	54.55	1,128	74.30	1,536	128.85	2,664
Grant	6,137	2,600.19	53,751	5,680.70	117,430	8,280.89	171,181
Jackson	98	163.07	3,371	403.66	8,344	566.73	11,715
Josephine	309	447.57	9,252	647.09	13,377	1,094.66	22,629
Lane	100	97.06	2,006			97.06	2,006
Linn				12.58	260	12.58	260
Malheur	690	341.51	7,060	56.32	1,164	397.83	8,224
Marion	71						
Wheeler				6.91	143	6.91	143
	44,842	10,945.32	226,260	15,750.04	325,582	26,695.36	551,842

County	Quartz silver		Placer silver		Total silver	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	25,070	$16,797	1,511	$1,012	26,581	$17,809
Coos			3	2	3	2
Crook			2	1	2	1
Curry	44	29	3	2	47	31
Douglas	81	54	10	7	91	61
Grant	10,274	6,884	584	391	10,858	7,275
Jackson	28	19	73	49	101	68
Josephine	71	48	81	54	152	102
Lane	46	31			46	31
Linn			4	3	4	3
Malheur	105	70	7	5	112	75
Marion	105	70			105	70
Wheeler			1	1	1	1
	35,824	24,002	2,279	1,527	38,103	25,529

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Baker	761,141	$99,709			$441,770
Coos					743
Crook					65
Curry					7,994
Douglas	88	12			2,737
Grant	947	124	513	$41	178,621
Jackson					11,783
Josephine					22,731
Lane					2,037
Linn					263
Malheur					8,299
Marion	6,219	815			885
Wheeler					144
	768,395	100,660	513	41	678,072

REVIEW BY COUNTIES

BAKER COUNTY

The value of the gold, silver, and copper produced in Baker County in 1924 was 65 per cent of the value of all metals produced in the State but was $107,386 less than what Baker County mines produced in 1923. Gold production increased $33,849 but silver decreased $51,285 and copper $88,083. No lead was produced in 1924.

There were 12 producing deep mines and 17 placer mines in Baker County in 1924, as compared with 22 deep mines and 44 placers in 1923. The value of the output of the deep mines decreased $176,484, and the quantity of gold produced by deep mines decreased 20 per cent. The ore produced in the county in 1924 was 10,369 tons less than in 1923, and the average value of the ore was $6.94 in metals per ton as compared with $9.14 in 1923. Of the total ore mined in 1924, 40 per cent was copper ore, 0.4 per cent silver ore, and approximately 60 per cent gold ore. Comparable figures for 1923 are 40, 4, and 56 per cent.

The gold ore mined averaged $4.74 a ton, practically all in gold and silver. The silver ore averaged $20.81 in gold and silver and $22.94 a ton in all metals, and the copper ore $3.38 in gold and silver and $10.11 in all metals.

Of the dry gold ore mined, 288 tons was treated at amalgamation mills, 21,435 tons at cyanide mills, and 600 tons at concentration mills. A total of 60 tons of gold concentrates that contained 5.11 ounces of gold and 12.58 ounces of silver to the ton was made.

All the siliceous silver ore and 14 tons of copper ore were shipped direct to smelters. The greater part of the copper ore was concentrated by flotation (about 3¼ into 1); the copper concentrates averaged 0.58 ounce of gold and 3.67 ounces of silver to the ton and 11.08 per cent copper.

Placer mining resulted in the recovery of gold and silver valued at $69,098 more than in 1923. The increase was largely due to the fact that dredges recovered 76 per cent and surface workings 370 per cent more bullion than in 1923. Hydraulic mines decreased their yield 80 per cent because of drought, and drift mining was 55 per cent less productive.

Cable Cove district.—At the Baisley-Elkhorn mine a new shaft was sunk during 1924, but no ore was milled. The Imperial Eagle and Herculean mines were idle.

Connor Creek district.—The Bay Horse mine was not particularly active, though some development was done and a little silver ore shipped. Most of the year was occupied with financial problems and plans for a new mill. Livingston [2] says that silver-bearing tennantite, the sole ore mineral at the Bay Horse mine, occurs in a fracture zone close to the contact between Permian andesite and a rhyolite flow, and probably does not extend into the overlying Triassic sediments. The ore replaces andesite and impregnates rhyolite. In the andesite the ore bodies, which dip west into the mountain, are persistent in strike but are irregular in size. The main

[2] Livingston, D. C., A Geologic Reconnaissance of the Mineral and Cuddy Mountain Mining District, Washington and Adams Counties, Idaho: Idaho Bur. of Mines and Geology Pamphlet 13, 1925, pp. 17–18.

developed ore body has a maximum width of 40 to 50 feet but it is badly displaced on the main tunnel level by a fault that dips south at a low angle. The western limit of the ore body has not been reached. Development consists of two tunnels, the upper 800 feet long, from which several crosscuts and stopes have been driven. The old lower tunnel, at 130 feet lowest elevation, has not yet been reopened. It is reported [3] that the Primos Chemical Co., of Philadelphia, has purchased 60 per cent of the stock of the United States Metals Co. and will direct future developments at the Bay Horse mine. A small amount of placer gold was recovered along Connor Creek.

Cornucopia district.—The Cornucopia Mines Co. continued to operate its Last Chance mine and the 70-ton cyanide plant at the Union; this property has been one of the most consistent producers in eastern Oregon. The Golden Hand drift mine produced and development continued at the Queen of the West.

Cracker Creek (Bourne) district.—The Ibex mine, operated by the Ibex-Bey Co., shipped siliceous concentrates. The E and E mine was idle. The North Pole mine, formerly operated by the Eastern Oregon Mining Co., was acquired by Emil Melzer but was not productive. No placer operations were reported from this region.

Greenhorn district.—Prospecting operations in the Greenhorn district gave a small output of siliceous gold ore, and the Blue Bucket and Trinidad hydraulic mines had water for a few days' run.

Homestead district.—The Homestead Iron Dyke property was not as productive as in 1923, though the mine was worked throughout the year and the mill ran 10 months. Nothing was done at the Copper Trust Syndicate property.

Keating (Eagle Creek) district.—Much interest has been shown in the development of copper properties in this district. The Mother Lode Copper Co. did several thousand feet of development and is said to have opened promising copper ore.

Rye Valley district.—The Black Rock and Rye Valley hydraulic properties each produced a little bullion, and a small amount was recovered at the Eva C and Fay quartz mine.

Snake River district.—About 60 ounces of gold was recovered by rocking on Snake River near Home.

Stice (Burnt River) district.—The Superior dredge on Burnt River near Bridgeport made the third largest output of gold in Oregon in 1924. The boat began digging in April and continued throughout the year, handling 793,157 cubic yards. Near Hereford the Tom-Tom, Bull Dog, and Cow Creek hydraulic mines had water for short runs.

Sumpter district.—The dredge of the Powder River company made its final clean-up July 23, 1924, after digging out its ground.

Virtue district.—The Ham and Day, Regan, and Virtue quartz mines were productive in a small way.

Weatherby district.—The Gleeson (old Dixie) mine was operated by Rizor & Lovejoy throughout the year and small millings were made in the spring and fall in the five-stamp amalgamation plant. The Chicken Creek drift mine yielded a few ounces of gold.

[3] Eng. and Min. Jour.-Press, vol. 120, 1925, p. 67.

COOS COUNTY

The beach placers near Bullards and Powers and "Old Beach" gravels on Johnson Creek were worked in a small way during 1924 but yielded 7 ounces less gold than in 1923.

CROOK COUNTY

A minor amount of placer gold was taken from Scissors Creek near Prineville in 1924, but no deep mines were productive in the county.

DOUGLAS COUNTY

The Continental mine on Myrtle Creek was further developed by its owner, W. C. Bates, and a shipment of siliceous gold ore was made to the Tacoma smelter. There was a small placer output at the Midget and other placers on Coffee Creek near Tiller, from the Victory, Regis, and Gordon hydraulic mines on Crackerjack Creek near Glendale, and from the Gopher placer near Drew.

GRANT COUNTY

In Grant County during 1924 production was made at 8 deep mines and 9 placers, as compared with 16 deep mines and 14 placers in 1923. The deep mines produced 6,137 tons of ore having an average value in metals of $9.91 a ton in 1924, as compared with 1,581 tons, averaging $23.46 a ton, in 1923. The value of bullion produced at placer mines in Grant County in 1924 was $12,618 less than in 1923. The decrease is attributed to smaller yield of the Empire dredge and to the decline in hydraulic operations because of drought. The dredge was the largest producer of gold in the county; the Cougar deep mine at Granite, operated by the Independence Mining Co., ranked second.

Cable Cove district.—As far as can be learned, none of the properties in the Cable Cove district were productive in 1924.

Canyon City district.—The Empire Gold dredge was the largest producer of gold in the State in 1924. The Caledonia hydraulic property was operated. Some gold was taken from the veins of the Mother Lode, Oregon, and Snowstorm claims on Canyon Mountain.

Granite district.—Siliceous gold ore was produced at the Buffalo-Monitor, Independence, and Ruby Creek mines in 1924. Most of the ore was concentrated by flotation, but some was shipped direct to smelters. A brief note concerning the flotation mill of the Buffalo-Monitor mine has been published.[4] The Big Nugget placer was productive. The Red Boy, La Belleview, Ben Harrison, and Rex mines were idle.

Greenhorn district.—No production was recovered from the Greenhorn district in 1924. The Morning and Tempest mines remained idle.

Prairie City district.—The Equity and Midnight quartz mines were productive in a small way, but the Standard and Comer, which were operated in 1923, were inactive. Small placer operations near Prairie City yielded about 60 ounces of gold; chief of these operations was at the Ray mine.

[4] Stowell, G. E., "Sodium sulphide and classification trouble": Eng. and Min. Jour.-Press, vol. 117, 1924, p. 362.

JACKSON COUNTY

During 1924, 7 deep mines and 9 placers were productive in Jackson County, as compared with 6 deep mines and 28 placers in 1923. The value of the production from the mines of Jackson County decreased 44 per cent as compared with 1923; the decline from deep mines was 51 per cent and from placers 40 per cent. The deep mines produced only 98 tons of ore in 1924, a decrease of 620 tons as compared with 1923, but the value in metals per ton in 1924 was $34.59, as compared with $9.62 a ton in 1923. Hydraulic mines accounted for 86 per cent and surface placers 14 per cent of the total yield from placer mines. The largest deep-gold mine was the Gilson pocket and the largest placer mine the Pacific hydraulic, near Applegate.

Applegate district.—No quartz mines in the Applegate district were productive in 1924, though development was under way at the Afterthought. Shortage of water permitted only brief, intermittent runs at the Pacific and Pittock hydraulic mines.

Ashland district.—Development continued at the Skyline mine on Wagner Creek, but the Barron mine was inactive.

Gold Hill district.—In the Foots Creek section the Highway Mining & Reduction Co. erected a five-stamp mill, at which some bullion was recovered. The Robinson Mining Co. had the North Pole mine under development, and the Red Ribbon mine was being developed. The Sylvanite property was idle. Near Gold Hill the Gold Ridge mine was developed under lease by P. X. Johnson and was reported sold under foreclosure proceedings in December. At the Standing Buck mine a small milling was made and two small pockets were found. The Millionaire mine was idle after March. The largest gold production of the district was made as a by-product at the Ancient River placer. A little placer gold was recovered at the Centennial hydraulic and by several snipers. On Sardine Creek the Blossom group of quartz claims was under development by the Wilvan Mining Co., of Seattle.

Jacksonville district.—At the Opp mine development continued, but no ore was milled. A fair-sized pocket was taken out by A. Gilson. Jacksonville banks sent to the mint 100 ounces of placer bullion and pocket gold of uncertain origin but probably produced locally.

Upper Applegate district.—The Sterling and Pearce hydraulic mines had water only for short runs early in the year, and production was much curtailed.

JOSEPHINE COUNTY

In 1924, 8 deep mines and 17 placer mines were producing in Josephine County, as compared with 4 deep mines and 33 placers in 1923. Nevertheless the total production from the county increased 36 per cent; the output from deep mines increased 127 per cent and that from placers 6 per cent. The 309 tons of siliceous gold ore treated by amalgamation yielded about $30 a ton on the plates. Of the placer output 58 per cent was produced by hydraulic operations and 42 per cent by surface and sluice mines.

Applegate district.—The Great I Am mine near the Jackson County line, out from Murphy, was leased to Peter & Andrews, who operated with some success.

Galice district.—A small milling was made at the Bunker Hill mine by W. S. Robertson. The Western Metal Mines Co. is developing and testing its Black Jack, Sugar Pine, Victor, and Golden Cycle mines, which yield milling ore. The new 10-stamp mill made a trial run on ore from the Black Jack mine. The company also owns a group of claims carrying veins of base metals; these were not operated in 1924. Development work continued at the Mount Reuben mines, and a small hydroelectric plant was installed; E. R. Wheeler acquired the properties in November, 1924. The Antler, Dean and Dean, Genevieve, and Old Channel hydraulic mines were operated, though water was available only for short runs. A wing-dam mine on Rogue River near Galice was fairly successful.

Grants Pass district.—A small milling on the Red Jacket claim was made in 1924. A cyanide plant was erected on the Ida group, consisting of the Wild Rose, Black Bear, and Black Jack claims.

Holland district.—The cyanide plant at the Boswell mine was in operation for a short time in 1924, but the mine was not further developed. The Associates Development Co. continued development at the Siskron mine and had water for milling during three months. The Kentta and Shorty Hope hydraulic mines were productive, but because of lack of water only a few of the placer mines in the district could wash gravel.

Kerby district.—The Anderson hydraulic and several small properties along Illinois River were worked in a small way during 1924. A small milling was made at the Myrtle quartz mine near Selma.

Waldo district.—The Osgood and Logan hydraulic mines were operated; at the latter new ground was prospected. No work was done at the various copper properties near Takilma.

Wolf Creek district.—The Knickerbocker and Blue Channel hydraulic mines were worked in 1924, and a Chilean mill was erected at the Thompson group of quartz mines.

LANE COUNTY

Bohemia district.—The Gold Leaf-Evening Star mines were productive in 1924, and considerable development work was accomplished. None of the other mines in the Bohemia district reported activity.

LINN COUNTY

The small placer output reported from Linn County resulted from prospecting along Blue River and near Quartzville.

MALHEUR COUNTY

A total of $1,169 was recovered by hydraulic mining on the Colt, Homestake, and Jed Blair placers in the Mormon Basin district. At the Gold Hill quartz mine on Willow Creek, 6 miles from Malheur, development was under way and some bullion was recovered. The Sapphire mine at Rye Valley made a test run at the Sunday Hill mill and continued development. The Sunday Hill mine, in operation from May to September, mined 560 tons of $10 gold ore which was treated at the five-stamp amalgamation mill. The Red, White, and Blue mine and the Rainbow mine were not operated.

MARION COUNTY

The Lotz Larsen Mining Co., developing the Minnie E mine in the Elkhorn district, out from Gates, shipped copper ore to Tacoma during 1924. It is reported [5] that the 1,500-foot adit at the Minnie E has developed a million tons of ore in the 800 feet vertical depth attained. The ore is said to run $2 to $5 in gold, 4 to 8 ounces in silver, and 4.28 per cent in copper. A small pilot flotation mill has been in operation, and a 1,000-ton mill is planned. The Silver King Mining Co., in the same district, was driving a crosscut to get under its ore.

WHEELER COUNTY

No work of consequence was done in the Spanish Gulch district in Wheeler County in 1924.

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[5] Mining Truth, Spokane (Wash.), Nov. 1, 1924, p. 2.

ZINC [1]

By C. E. Siebenthal and A. Stoll

SUMMARY

Zinc produced and consumed in the United States, 1923–24, in short tons

	1923	1924
Production of primary zinc:[a]		
From domestic ore	508,335	515,831
From foreign ore	2,099	1,508
	510,434	517,339
Production of secondary zinc:[a]		
Redistilled	39,434	35,486
Remelted	25,776	23,400
	65,210	58,886
	575,644	576,225
Apparent consumption of primary zinc	446,514	448,257

[a] "Primary zinc," which is produced directly from ore, is here distinguished from "secondary zinc," which is obtained by refining zinc ashes, skimmings, drosses, and old metals. The statistics of secondary zinc are given on p. 239. Wherever in this report the word "zinc" is used without qualification it means primary zinc.

Owing to necessary economies in Government printing it has been deemed advisable to omit the notes explaining the tables in these reports. The reader will find the full notes in the chapter on zinc in Mineral Resources for 1918. For the same reason the period covered by the tables has generally been limited to the years 1919–1924, and some tables have been omitted.

PRODUCTION

PRIMARY ZINC

Primary zinc produced in the United States, 1919–1924, in short tons

Apportioned according to source of ore

	1919	1920	1921	1922	1923	1924
Total domestic [a]	452,272	450,045	198,232	353,274	508,335	515,831
Foreign:						
Canada	4,007	1,583	521	55		1,396
Mexico	8,083	8,978	1,614	948	2,099	112
South America	751	536				
Australia	630	2,235	133			
Total foreign	13,471	13,332	2,268	1,003	2,099	1,508
Total primary	465,743	463,377	200,500	354,277	510,434	517,339

[a] The slab zinc which was rolled is included here.

[1] Chapters on zinc that were more than ordinarily detailed were issued in Mineral Resources for 1908, dealing largely with metallurgy; for 1915, dealing with the zinc deposits of the United States and foreign countries; and for 1918, dealing with the zinc industry in relation to the World War.

Primary zinc produced in the United States, 1919–1924, in short tons—Continued

Apportioned according to locality at which reduced

	1919	1920	1921	1922	1923	1924
Arkansas	31,437	31,481	15,278	13,627	29,870	28,447
Illinois	118,458	109,056	48,865	76,266	93,239	93,370
Kansas	43,942	41,044	16,573	24,167	32,006	28,640
Oklahoma	121,988	110,500	41,244	74,537	119,744	118,487
Pennsylvania	67,521	74,234	36,378	57,319	82,003	83,016
Other States	82,397	97,062	42,162	108,361	153,572	165,379
	465,743	463,377	200,500	354,277	510,434	517,339

DISTILLED AND ELECTROLYTIC ZINC

Secondary zinc materials, such as zinc ashes and scrap, carefully selected and redistilled, yield slab zinc of all grades, which enters the market for practically all purposes. Considerable secondary material is mixed with ore and used by some regular ore smelters. The quantity of metal so derived can be calculated by the smelters and thus eliminated from the output of primary zinc, but it is practically impossible to segregate the redistilled secondary zinc by grades or in smelter stocks. Hence the smelter stocks as given contain some secondary zinc, and the statistics of production of zinc by grades as given in the table below likewise include secondary zinc. The quantity of secondary zinc included in the graded zinc is given in the first part of the table, which gives the source of the graded zinc by the methods of reduction.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1919–1924, in short tons

Apportioned according to method of reduction

	1919	1920	1921	1922	1923	1924
Electrolytic	27,056	51,626	11,559	55,369	71,088	77,493
Distilled primary	438,687	411,751	188,941	298,908	439,346	439,846
Redistilled secondary zinc [a]	19,748	21,371	17,573	32,988	39,434	35,486
	485,491	484,748	218,073	387,265	549,868	552,825

Apportioned according to grade

Grade A (high grade)	45,377	80,713	24,084	67,459	89,739	108,238
Grade B (intermediate)	39,173	33,893	4,996	36,402	58,513	48,874
Grade C (select and brass special)	140,917	59,811	47,814	49,980	90,459	100,290
Grade D (prime western)	260,024	310,331	141,179	233,424	311,157	295,423
	485,491	484,748	218,073	387,265	549,868	552,825

[a] For total production of secondary zinc, see p. 239.

ROLLED ZINC

The following table includes the exports as shown by the records of the Bureau of Foreign and Domestic Commerce. If the figures showing the exports are deducted from those showing the production plus the imports, the result will approximate the quantity available for domestic consumption. The slab zinc rolled is included in the domestic output of zinc as given on page 235.

Zinc rolled in the United States, 1923–24

	1923			1924		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
Sheet zinc not over 0.1 inch thick	49, 179, 501	$4, 529, 075	$0. 092	59, 033, 193	$5, 669, 867	$0. 096
Boiler plate and sheets over 0.1 inch thick	2, 294, 230	186, 415	. 081	1, 982, 526	160, 893	. 081
Strip and ribbon zinc	60, 192, 743	5, 449, 491	. 091	61, 049, 000	5, 721, 594	. 094
Total rolled zinc	111, 666, 474	10, 164, 981	. 091	122, 064, 719	11, 552, 354	. 095
Slab zinc, grades B and C [a]			. 068			. 065
Spread			. 023			. 030
Sheet zinc imported for consumption	584	41	. 070	712	88	. 124
Rolled zinc exported	7, 463, 362	764, 369	. 102	7, 315, 144	784, 728	. 107
Available for consumption	104, 203, 696			114, 750, 287		

[a] The average price of the grades of zinc which are commonly rolled is given for comparison with the average price of rolled zinc.

The difference, or "spread," between the average price per pound of grades B and C zinc, which are those used in rolled zinc, and the average price per pound of zinc sheets is given in the foregoing table. During the later part of the World War the great demand for zinc sheets for packing munitions sent the price to a high figure, with a resulting wide difference between the price of sheets and of the metal, reaching over 6 cents a pound. During 1923 and 1924, however, the spread has been 2.3 and 3 cents, respectively.

Producers of rolled zinc in the United States in 1924

Operator	Location of plant
American Zinc Products Co	Greencastle, Ind.
Ball Bros. Co	Muncie, Ind.
Edes Manufacturing Co	Plymouth, Mass.
Hazel-Atlas Glass Co	Wheeling, W. Va.
Illinois Zinc Co	Peru, Ill.
Matthiessen & Hegeler Zinc Co	La Salle, Ill.
New Jersey Zinc Co	Palmerton, Pa.
Platt Bros. & Co	Waterbury, Conn.

ZINC DUST

The following table includes zinc dust made from both ores and secondary materials, as well as from slab zinc. To avoid duplication in the last column, giving "primary zinc recovered in zinc dust," all zinc in zinc dust made from slab zinc already counted in slab-zinc production is excluded. Statistics of the quantity of secondary zinc recovered as zinc dust are given in the table headed "Secondary zinc."

Zinc dust sold by producers in the United States, 1919–1924

Year	Prepared "blue powder"			Zinc dust "atomized"			Primary zinc recovered as zinc dust (short tons)
	Short tons	Value		Short tons	Value		
		Total	Average per pound		Total	Average per pound	
1919	4,083	$801,366	$0.098	2,715	$566,294	$0.104	3,430
1920	9,066	2,009,117	.111	2,463	555,773	.113	6,425
1921	2,006	333,390	.083	999	152,151	.076	1,380
1922	3,394	531,225	.078	3,859	573,220	.074	2,113
1923	3,676	643,766	.088	4,376	702,923	.080	2,450
1924	3,894	620,078	.080	4,063	621,221	.076	1,861

The average price of zinc dust, "blue powder," as calculated from sales during the year, was 8 cents a pound; "atomized" zinc dust brought 7.6 cents a pound. "Blue powder" brought a higher average price than "atomized" dust, because much of it was sold in the far West, where higher prices prevailed. The weekly fluctuation in the quoted price of zinc dust is shown in Figure 7 (p. 253).

The following operators reported the production of zinc dust in 1924:

Bartlesville Zinc Co., Bartlesville, Okla.
John Finn Metal Works, San Francisco, Calif.
Grasselli Chemical Co., Clarksburg, W. Va.
The Merrill Co., San Francisco, Calif.
New Jersey Zinc Co., Palmerton, Pa.
United States Zinc Co., Sand Springs, Okla.

ZINC PIGMENTS AND SALTS

Zinc forms the base, either in whole or in part, of three white pigments—zinc oxide, leaded zinc oxide, and lithopone. Two zinc salts, the chloride and the sulphate, are likewise made in part from ore and in part from secondary zinc. Details of the production of zinc pigments and salts and of market conditions are given in the chapter on lead and zinc pigments and salts.

The zinc content of the pigments and salts made in the United States from ore, both domestic and foreign, for the period 1919–1924, is given in the table below. Statistics of the secondary zinc recovered in the form of pigments and salts are given under the next heading.

Primary zinc content of zinc pigments and salts made in the United States, 1919–1924, in short tons

Year	Salts	Pigments	Year	Salts	Pigments
1919	3,393	96,817	1922	1,801	93,112
1920	6,284	110,695	1923	1,573	115,970
1921	3,749	53,480	1924	1,075	108,282

SECONDARY ZINC

Secondary zinc recovered in the United States, 1921–1924, in short tons [a]

	1921	1922	1923	1924
Secondary zinc, redistilled	17,573	32,988	39,434	35,486
Secondary zinc, remelted	16,260	36,326	25,776	23,400
Recovered zinc in alloys, excluding old brass remelted	5,840	10,250	8,630	10,500
Recovered zinc in remelted brass (estimated)	38,600	60,000	65,000	63,000
Secondary zinc recovered as metal	78,000	140,000	139,000	132,000
Secondary zinc recovered in zinc dust	755	3,405	3,962	5,093
Secondary zinc recovered in pigments	4,024	8,609	10,322	9,021
Secondary zinc recovered in zinc salts	10,225	9,016	10,719	10,225
Total secondary zinc	93,000	161,000	164,000	157,000

[a] See p. 235 for definition of secondary zinc.

BY-PRODUCT SULPHURIC ACID

An important by-product of zinc-smelting operations is the sulphuric acid made from the sulphur gases evolved in roasting the zinc sulphide ores preparatory to their distillation or conversion to zinc oxide or to zinc salts. Sulphur gases from zinc ores were first thus utilized by Matthiessen & Hegeler, at La Salle, Ill., in 1882, but now there are numerous acid plants using these gases. These acid plants may be at zinc smelters and zinc oxide plants, at roasting and magnetic separating plants, at the mines, or nearer the acid markets, the roasted concentrates being shipped to the smelters or to other zinc plants.

The following table gives the output of by-product sulphuric acid made at or in association with zinc-blende roasting plants in 1919, 1921, and 1923, as collected by the Bureau of the Census, and in 1924, as collected by the Bureau of Mines in the canvass of the output of zinc smelters:

By-product sulphuric acid produced at zinc-blende roasting plants in the United States, 1919, 1921, 1923, and 1924

	1919	1921	1923	1924
Number of establishments	14	14	11	22
Acid reported as 50°–60° B.:				
Produced, short tons	397,198	233,136	290,370	[a] 507,208
Consumed at works, do	7,732	37,242		[a] 32,721
Sold, do	389,466	195,894	290,370	[a] 464,483
Value of acid sold:				
Total	$4,698,035	$2,155,314	$2,453,964	$4,203,619
Average	$12.06	$11.00	$8.45	$9.05
Acid reported as 66° B. and stronger:				
Produced, short tons	79,148	72,038	76,809	[b] 354,417
Consumed at works, do	5,287	7,439		[b] 40,484
Sold, do	73,861	64,599	76,809	[b] 308,951
Value of acid sold:				
Total	$1,467,301	$1,248,654	$921,056	$4,248,640
Average	$19.87	$19.33	$12.00	$13.75
Total acid sold, equivalent in 60° B.:				
Quantity, short tons	502,324	286,826	384,489	835,225
Value	$6,165,336	$3,403,968	$3,375,020	$8,452,259
Consumed at works (60° B.), short tons	15,598	48,698	[c]	81,302

[a] Expressed as 60° B. [b] Expressed as 66° B. [c] Figures not available.

The foregoing table gives the output of sulphuric acid by strengths, as well as that sold and that consumed in the works. Some of the lower acids are concentrated to higher strengths, and proper care has been taken to see that there is no duplication. The table, however, gives no indication of the origin of the SO_3 gas, whether from roasting the sulphide ores, zinc blende, and pyrite, or burning sulphur or brimstone. During the war all these materials were used, but in 1924 no pyrite was burned for acid and no SO_3 gas was derived from roasting foreign zinc blende, the by-product sulphuric acid made by zinc plants being derived wholly from domestic zinc blende and brimstone. The quantity of each material used, together with the equivalent of the acid made from it, expressed in 60° B., and its value at the average price of 60° B. acid are given, so that the value of the sulphur gases realized from working the zinc ores may be seen. Only plants which have made a business of using zinc sulphide ores are given, but where such plants used only brimstone in 1924 the acid is included as being strictly analogous to that made at these plants by burning brimstone in other years when both sulphide ores and brimstone were used.

In all, 22 plants are listed in 1924, of which 2 used only sulphur and 3 used only blende, the remainder using both, but 7 plants used only a little sulphur, averaging only 350 tons each.

Production and value of sulphuric acid made from blende and sulphur at zinc-blende roasting plants in the United States in 1924[2]

Number of establishments		22
Blende used	short tons	529, 135
Acid made, equivalent in 60° B	do	520, 361
Value at $9.05 per ton (average of sales of 60° B.)		$4, 709, 000
Brimstone used	short tons	110, 226
Acid made, equivalent in 60° B	do	419, 865
Value at $9.05 per ton (average of sales of 60° B.)		$3, 800, 000
Total quantity of acid	short tons	940, 226
Total value of acid		$8, 509, 000

MINE PRODUCTION

The preceding tables, except those for sulphuric acid, give the quantity of zinc recovered either as metal by smelting and by electrolytic reduction, or in zinc dust, or as zinc in pigments and salts. The following table shows the origin of the domestic zinc that is recovered by metallurgical operations. The origin of the zinc by States is obtained more accurately from the reports of mines, because smelters necessarily treat mixtures of ores, sometimes long after they have been received, so that the actual output of metallic zinc may not correspond at all closely to the product of the mines for the same year. The data for the tables of mine production are taken from the reports on gold, silver, copper, lead, and zinc in the different States. Deduction has been made for loss in smelting, so that the following figures represent zinc that should be recovered.

[2] The distribution of the sulphuric acid according to source as between blende and brimstone is to a certain extent an estimate based on calculation, and because of this and because of lag in sales and use, the total by source is slightly in excess of the total of that sold and used, the quantity being 940,226 tons and 916,527 tons, respectively.

Mine production of recoverable zinc in the United States, 1919–1924, in short tons

State	1919	1920	1921	1922	1923	1924
Arizona	859	729		105	260	
Arkansas	189	329	15	134	148	4
California	236	583	[a] 423	1,506		1,530
Colorado	18,610	24,395	1,180	11,629	27,076	28,364
Idaho	7,997	13,966	17	2,055	13,976	7,670
Illinois	6,788	4,720	2,426	3,124	1,266	2,512
Kansas	47,636	61,073	36,994	56,225	100,969	105,392
Kentucky	36	9	220	142	270	492
Missouri	31,540	24,509	10,845	16,171	18,265	12,920
Montana	84,382	92,169	11,638	59,535	70,730	64,238
Nevada	4,502	5,349	35	1,309	7,083	5,501
New Jersey	92,516	78,511	56,447	73,657	75,227	84,370
New Mexico	3,797	5,007	114	2,248	8,248	10,380
New York	5,120	5,654	1,572	4,816	8,463	4,664
Oklahoma	178,410	219,727	121,372	209,682	242,421	269,137
Tennessee	23,247	19,217	9,692	15,568	15,900	14,376
Utah	2,216	4,079	35	2,560	5,665	9,281
Virginia						2,664
Washington		213	225	614	1,512	455
Wisconsin	40,765	27,285	3,390	10,952	13,211	14,027
	548,846	587,524	[a] 256,640	472,032	610,690	637,977

[a] Revised figures.

The following table gives the production of the chief zinc-producing districts of the United States in the order of their output in 1915, when war-time production was in its full stride, through the slump of 1921, until the present year when the mine production of zinc is greater than it was in the closing year of the war. Most districts fell off in output during the period covered by the table, but the Joplin region in 1924 produced 140,000 tons more zinc than in its banner war-time year. Franklin Furnace, N. J., and Butte, Mont., alternated regularly between second and third place from 1915 to 1920; the former has, however, occupied second place during the last four years.

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1915–1924, in short tons

District	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Joplin region (Missouri-Kansas-Oklahoma)	164,544	196,596	238,768	247,516	257,514	305,290	169,211	282,078	361,655	387,449
Franklin Furnace, N. J	118,187	111,872	121,043	102,318	92,516	78,511	56,447	73,657	75,227	84,370
Butte, Mont	93,231	112,293	90,158	102,482	83,647	91,906	11,451	58,971	70,506	63,918
Upper Mississippi Valley region (Wisconsin-northern Illinois-Iowa)	46,937	60,228	64,027	53,806	47,553	32,005	5,816	14,076	14,429	15,670
Leadville, Colo	36,212	38,004	29,835	23,343	11,583	9,377	905	4,502	4,695	4,561
Coeur d'Alene region, Idaho	34,843	43,119	38,862	21,831	7,997	13,966	17	2,033	13,976	7,654
Eastern Tennessee	16,461	26,428	28,498	21,071	23,247	19,217	9,692	15,568	15,900	14,376
Yellow Pine, Nev	10,531	14,445	10,268	7,722	2,987	4,691	35	446	4,378	3,955
Magdalena, N. Mex	9,219	9,656	7,358	5,751	1,498	1,882	67	1,560	1,711	1,912
Wallapai (Union Basin), Ariz	8,691	8,512	8,564	41						
Red Cliff, Colo	5,571	14,219	11,858	7,423	1,684	3,327		5,500	11,800	11,066
Shasta region, Calif	4,199	3,932	3,160	1,523	40	149	[a] 423	1,477		1,530
Breckinridge, Colo	4,145	6,727	9,751	7,799	2,024	4,168		489	3,668	1,593
Park City region, Utah	3,886	2,568	2,601	1,715	640	1,721			3,729	3,393
Northern Arkansas	3,209	6,815	6,691	951	189	329	15	134	148	4
Central, N. Mex	2,814	3,639	3,699	4,413	2,150	3,067	48	667	6,509	8,461
Bingham, Utah	2,746	[b] 5,658	[b] 4,402	[b] 5,580	1,283	1,057	35	2,317	1,542	5,739
Edwards, N. Y	2,455	4,507	5,192	3,776	5,120	5,654	1,572	4,816	8,463	4,664
Cerro Gordo, Calif. [c]	2,328	2,901	1,978	1,256	112	434		29		
Tintic, Utah	1,923	1,856	591	132	47	90		12	159	79
Southwestern Virginia	1,267	2,276	1,703	951						2,664
Eureka, Colo	1,125	1,941	1,545	1,705	917	[d] 5,919		[d] 650	[d] 4,770	[d] 8,790
Pinos Altos, N. Mex	227	3,371	2,778	1,507	134	22			22	
	574,751	681,563	693,330	624,612	542,882	582,782	255,734	468,982	603,287	631,848
Percentage of total United States mine production	98	97	97	98	99	99	99+	99	99	99

[a] Revised figures.
[b] Includes zinc from Bingham tailings reworked at Smelter, Utah.
[c] Total zinc output from Inyo County.
[d] San Juan County; may include some zinc from Animas district in addition to that from Eureka district.

COMPARISONS OF PRODUCTION BASED ON SMELTER AND ON MINE REPORTS

The figures of the smelter production of domestic primary slab zinc are given in the foregoing pages. The mine figures are the totals for all the States as given in part on page 241. In order to put the smelter figures on a basis comparable with the mine figures all the zinc manufactured directly from domestic ore into pigments and from and including 1919 into zinc salts is added to the metallic zinc production. The zinc content of zinc dust ("blue powder") and of such "atomized" zinc dust as is made from metallic zinc not already taken into statistical account is also included with the metallic zinc. The zinc recoverable at foreign smelters from zinc ores exported from the United States is also included in the recovered zinc given in the comparison table or balance sheet, but the zinc recovered from secondary sources is excluded, for it has already been once reckoned as zinc. Likewise the zinc in zinc oxide made from metallic zinc and the zinc content of "atomized" zinc dust made from metallic zinc already counted have been left out, as their inclusion would entail a duplication to that extent. These facts must be borne in mind in comparing the smelter totals of the subjoined table with previous tables showing the smelter production of zinc.

It is not to be expected that all the recoverable metal mined in any year will be recovered by the smelters in that year, for there is always more or less lag either in smelting or in mining. In some years smelting will lag and more ore will remain in the smelter bins at the end than at the beginning of the year and the difference will show a "mine excess"—that is, more ore was mined than was smelted. In other years the demand for metal may exceed the rate of ore production and thus cause a depletion of the stocks of ore and show a "smelter excess." For a fairly long series of years these differences should be compensatory. Underestimating the loss in smelting, however, will result in overestimating the recoverable metal—the mine production—and thus indicate an unduly large "mine excess," and this exaggeration will continue until a proper correction is made in the factor applied, though at times such an increase may be overbalanced by smelter activity. On the other hand, overestimating the loss in smelting because of an excessive deduction factor will result in a continuing smelter excess. An increase in the number and capacity of smelting plants, pigment plants, and chemical plants using ore necessarily results in larger working stocks of ore, and in larger quantities of "material in process," each of which, of course, shows up as mine excess, because each increase locks up raw material that can not be turned into finished product and figure as smelter production unless ore purchases are reduced and stocks of ore are worked up.

Domestic primary zinc balance sheet, 1907–1924

[Short tons]

Year	Recoverable zinc (mine production)	Recovered zinc (smelter production) [a]	Mine excess (+) or smelter excess (−)	Year	Recoverable zinc (mine production)	Recovered zinc (smelter production) [a]	Mine excess (+) or smelter excess (−)
1907	253,017	288,817	−35,800	1917	713,556	685,400	+28,156
1908	234,064	248,473	−14,409	1918	636,091	597,772	+38,319
1909	302,373	288,155	+14,218	1919	548,846	553,833	−4,987
1910	324,444	311,023	+13,421	1920	587,524	569,011	+18,513
1911	331,515	322,341	+9,174	1921	[b] 256,640	255,448	+1,192
1912	385,621	396,123	−10,502	1922	472,032	449,740	+22,292
1913	413,824	415,374	−1,550	1923	610,690	629,052	−18,362
1914	415,774	429,116	−13,342	1924	637,977	626,967	+11,010
1915	588,060	539,407	+48,653				
1916	703,169	656,906	+46,263		8,415,217	8,262,958	+152,259

[a] Zinc in slab zinc, in pigments, salts, and zinc dust made from domestic ores, and the recoverable zinc content of exported ore.
[b] Revised figures.

As the discrepancy between mine and smelter production in a period of 18 years is only 1.8 per cent, the assumed smelting loss is evidently not far from the correct figure; the discrepancy becomes still smaller if allowance is made for the fact that smelting capacity increased in that time, and the attendant increase in ore stock was included in mine production but has not yet appeared in the production of recovered zinc.

ZINC-REDUCTION PLANTS

Zinc-smelting plants operating in the United States in 1924

Operating company (A=acid plant; not necessarily at the smelter)	Location of plant	Retorts
ARKANSAS		
Athletic Mining & Smelting Co	Fort Smith	3,328
Falcon Zinc Co	Van Buren	3,200
Fort Smith Spelter Co	Fort Smith	2,560
ILLINOIS		
American Zinc Co. of Illinois (A)	East St. Louis	5,620
Do. (A)	Hillsboro	4,864
Hegeler Zinc Co. (A)	Danville	5,400
Illinois Zinc Co. (A)	Peru	5,560
Matthiessen & Hegeler Zinc Co. (A)	La Salle	6,132
Mineral Point Zinc Co. (A)	Depue	9,068
Missouri Zinc Co	Beckemeyer	500
INDIANA		
Grasselli Chemical Co. (see note)	Terre Haute	4,200
KANSAS		
Edgar Zinc Co	Cherryvale	4,800
Weir Smelting Co	Caney	1,920
OKLAHOMA		
Bartlesville Zinc Co	Bartlesville	5,184
Blackwell Zinc Co. (Inc.)	Blackwell	9,600
Eagle-Picher Lead Co. (see note)	Henryetta	4,800
National Zinc Co. (see note)	Bartlesville	4,256
Quinton Spelter Co	Quinton	2,016
Tulsa Fuel & Manufacturing Co	Collinsville	3,392
United States Zinc Co	Henryetta	3,200
Do	Kusa	3,760

Zinc-smelting plants operating in the United States in 1924—Continued

Operating company (A=acid plant; not necessarily at the smelter)	Location of plant	Retorts
PENNSYLVANIA		
American Steel & Wire Co. (A)	Donora	7,904
American Zinc & Chemical Co. (A)	Langeloth	5,168
New Jersey Zinc Co. (of Pennsylvania) (A)	Palmerton	7,200
TEXAS		
United States Zinc Co.	Amarillo	4,000
WEST VIRGINIA		
Grasselli Chemical Co. (see note)	Clarksburg	5,760
Do.	Meadowbrook	8,400
United Zinc Smelting Corporation (A)	Moundsville	2,368
		134,160

NOTE.—The Grasselli Chemical Co. operates acid plants in connection with its zinc-roasting furnaces at Grasselli, Ind.; Canton, Cleveland, Lockland (near Cincinnati), and Niles, Ohio; and New Castle, Pa., and smelts the roasted zinc concentrates at the smelters at Terre Haute, Ind., and Clarksburg and Meadowbrook, W. Va. The Eagle-Picher Lead Co. operates the acid plant in connection with its idle smelter at Hillsboro, Ill. The National Zinc Co. has roasting furnaces and an acid plant at Argentine, Kans. The American Zinc Oxide Co., Columbus, Ohio, has installed a zinc-roasting plant and disposes of the sulphur gases to the neighboring acid plant of the Farmers' Fertilizer Co. The Bertha Mineral Co. operates roasting furnaces and an acid plant at Tiltonsville, Ohio.

The number of retorts at zinc smelters at the end of 1924 was 134,160 at 28 plants that had operated some time during the year. The number of retorts in operation at the end of the year was 81,435 at 24 plants, compared with 86,670 in operation at 28 plants at the end of 1923. The plant of the American Zinc Co. of Illinois, at Hillsboro, was idle at the end of the year.

In addition to the regular retort smelters the electrolytic zinc plant of the Anaconda Copper Mining Co., at Great Falls, Mont., with a capacity of 7,500 tons per month, operated throughout the year. It is announced that a one-third increase in capacity will be made immediately.

The following operators treated secondary materials in large graphite retorts during the year:

General Smelting Co., Philadelphia, Pa.
Tottenville Copper Co., Tottenville, N. Y.
Trenton Smelting & Refining Co., Trenton, N. J.
Wheeling Steel Corporation, Wheeling, W. Va.

The United States Zinc Co. added a fifth block of 800 retorts at its plant at Amarillo, Tex.

The American Smelting & Refining Co. completed the erection of a zinc smelter of two blocks of furnaces, including 1,600 retorts, at Rosita, Coahuila, Mexico, in connection with the by-product coke plant. A 30-ton acid plant will be operated and ammonium sulphate will be made.

The Consolidated Mining & Smelting Co., at Trail, B. C., has doubled the capacity of its electrolytic zinc plant from 100 to 200 tons daily.

TRADE CONDITIONS

WORLD'S PRODUCTION

In the following table, prepared by W. I. Whiteside, of the Bureau of Mines, the figures in black-faced type are taken from the official statistics of the countries named; those in ordinary type for Austria, China, and Czechoslovakia are the figures of Rudolph Wolff & Co., of London; other figures in ordinary type are taken from the 1924 yearbook of the American Bureau of Metal Statistics, an association of the copper producers, lead producers, and principal zinc producers of the United States. Official statistics will be substituted in this record as fast as they are made available.

There is always a possibility of duplication in figures showing European production, for some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc is included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in the statement of its production figures for the domestic output of secondary zinc.

World's smelter production of zinc, 1918–1924, in metric tons, by countries where smelted

Country	1918	1919	1920	1921	1922	1923	1924
Australia:							
New South Wales	**5,712**	**3,625**	**4,136**				
Tasmania	**3,883**	**3,727**	**5,902**	**1,136**	**23,894**	**41,814**	**47,423**
Austria	[a] 12,000			240	250		[b]
Belgium	**9,245**	**19,860**	**84,260**	**66,150**	**112,290**	**148,080**	**161,700**
Canada	**11,139**	**11,182**	**16,798**	**24,035**	**25,533**	**27,238**	**24,896**
China	[b]	[b]	180	1,290	406	508	**250**
Czechoslovakia	[c]	2,091	4,267	6,706	2,337	4,877	**6,897**
France	**18,347**	**10,800**	**20,085**	**24,168**	**39,716**	49,334	55,599
Germany:							
Upper Silesia	**122,961**	**74,023**	**81,482**	**62,630**	[d] **36,615**	[e]	[e]
Other Germany	**62,212**	**23,381**	**16,494**	**66,472**	**41,535**	32,175	41,438
Great Britain	39,001	38,227	25,000	5,910	18,624	31,782	39,098
Italy	**1,188**	**1,282**	**1,177**	**527**	**3,082**	**3,681**	**5,959**
Japan	**39,915**	**19,816**	**15,745**	**10,374**	**12,526**	**13,780**	**14,069**
Netherlands	**681**		**2,031**	**6,405**	**12,997**	**16,440**	**18,190**
Norway	1,855	3,386	1,837	2,000	1,850	**3,783**	**5,024**
Poland:							
Upper Silesia	[f]	[f]	[f]	[f]	[g] **42,275**	**83,847**	**76,708**
Other Poland	[h]	**4,652**	**5,361**	**5,000**	**9,126**	**11,831**	**20,000**
Russia	4,893	[b]	[b]	[b]	118	**19**	[i] **516**
Spain	**15,900**	**16,314**	**9,647**	**6,738**	**6,269**	**10,922**	**12,777**
Sweden	**4,098**	**2,321**	**5,759**	**3,510**	**1,550**	**1,214**	**3,451**
United States	**469,853**	**422,513**	**420,366**	**181,890**	**321,393**	**463,056**	**469,320**
Yugoslavia	[c]	**1,919**	**1,511**	**420**	**1,056**	**1,947**	**2,126**
Known production	823,000	659,000	722,000	476,000	713,000	946,000	1,005,000

[a] Represents old Austrian Empire and includes territories now included under Czechoslovakia and Yugoslavia.
[b] Data not available.
[c] Included under Austria.
[d] First six months; for second six months see Poland.
[e] See Poland, as zinc smelters are in territory allotted to Poland.
[f] See Germany.
[g] Second six months; for first six months see Germany.
[h] Included under Russia.
[i] Data for operating year, Oct. 1, 1923, to Sept. 30, 1924.

The following table, also prepared by W. I. Whiteside, shows the output of zinc ore by different countries in the years 1920–1924, inclusive. The zinc content is estimated where possible, but many official reports give no information on which such an estimate could be based.

World's mine production of zinc ore and concentrates, with estimated zinc content, 1920–1924, in metric tons

Country	1920		1921		1922		1923		1924	
	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content
North America:										
Canada	226,011	41,292	269,801	44,814	323,043	46,709	(a)	(a)	(a)	(a)
Mexico (imports into United States)	43,048	13,585	5,488	1,948	(a)	1,510	(a)	2,905	(a)	4,217
United States (recoverable zinc)	(a)	532,990	(a)	[b]232,819	(a)	428,218	(a)	554,006	(a)	578,760
South America:										
Bolivia (exports)	1,206	(a)	------	------	------	------	390	(a)	469	(a)
Europe:										
Austria [c]	1,125	434	103	40	30	12	1,168	472	1,227	488
Belgium	(a)	(a)	(a)	(a)	26	(a)	36	(a)	850	(a)
Bulgaria	(a)	(a)	(a)	(a)	75	(a)	(a)	(a)	(a)	(a)
Czechoslovakia	2,077	(a)	1,781	(a)	1,316	(a)	25	(a)	690	(a)
Finland	9,180	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
France	23,505	11,000	16,249	7,500	4,660	2,000	10,940	5,000	15,072	7,000
Germany—										
Upper Silesia	243,308	92,257	217,921	(a)	97,990	(a)	77,691	(a)	(a)	(a)
Other Germany	48,147	21,733	79,193							
Greece—										
Zinc ore	2,591	(a)	1,920	(a)	1,149	(a)	4,026	(a)	4,861	(a)
Zinc-lead ore	2,636	(a)	858	(a)	132	(a)	314	(a)	81	(a)
Italy—										
Zinc ore	95,985	41,000	69,000	29,000	82,266	35,000	132,596	52,000	151,473	58,000
Zinc-lead-copper ore	570	60	840	80	430	40	1,711	400	4,989	(a)
Norway	148	(a)	7	(a)	552	(a)	2,226	(a)	1,389	(a)
Poland—										
Upper Silesia	(d)	(d)	(d)	(d)	227,881	(a)	213,814	(a)	236,812	(a)
Other Poland	64,354	(a)	58,824	(a)	66,400	(a)	86,708	(a)	(a)	(a)
Portugal	(a)	(a)	(a)	(a)	1,200	600	22	11	------	------
Russia	(a)	(a)	3,767	(a)	795	(a)	2,314	(a)	[e]7,397	(a)
Spain	94,095	28,250	48,357	17,446	71,996	23,954	102,313	38,050	116,721	41,921
Sweden	47,674	16,609	29,426	11,025	38,023	14,186	41,912	15,719	47,691	17,775
United Kingdom	5,145	1,682	827	297	1,646	590	2,158	950	2,354	826
Yugoslavia	278	(a)	126	(a)	288	(a)	618	(a)	549	(a)
Asia:										
China (exports)	9,116	(a)	11,928	(a)	61,242	(a)	61,064	(a)	20,456	(a)
Chosen	3,483	(a)	141	(a)	------	------	(a)	(a)	1,051	(a)
India (British)	76	(a)	4,064	(a)	18,351	(a)	2,095	(a)	18,949	(a)
Indo China	7,198	3,455	11,035	5,297	20,936	9,421	30,500	12,800	42,451	17,829
Japan	702,985	(a)	24,707	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Turkey	1,514	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Africa:										
Algeria	26,562	11,156	14,550	6,693	31,439	13,500	[f]49,331	20,200	42,759	17,831
Rhodesia, Northern	------	------	18	(a)	3	(a)	44	(a)	------	------
Tunisia	12,575	5,030	4,541	1,816	8,868	3,547	12,000	4,800	14,811	5,200
Union of South Africa	2,131	(a)	1,161	(a)	------	------	------	------	------	------
Oceania:										
Australia	72,183	35,000	80,973	39,000	365,518	172,000	432,887	195,000	359,326	162,000

[a] Data not available.
[b] Revised figures.
[c] Data represent zinc ore only; lead-zinc ores not included.
[d] See Germany.
[e] Data for operating year, Oct. 1, 1923, to Sept. 30, 1924.
[f] Includes small quantity of zinc-lead ore.

IMPORTS AND EXPORTS

The following tables of imports and exports of zinc and of zinc remaining in warehouses have been compiled from the publications and records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the Bureau of Mines:

Zinc remaining in warehouse in the United States, December 31, 1919–1924

Year	Ore and calamine		Blocks, pigs, and old		Zinc dust	
	Zinc content (pounds)	Value	Pounds	Value	Pounds	Value
1919	37,696,007	$674,384				
1920	51,299,109	996,386				
1921	28,583,018	647,654	262,221	$10,911		
1922			160,976	6,396		
1923	1,736,874	84,977	160,976	6,396	[a] 2,048	[a] $256
1924	12,103,110	494,605			[a] 998	[a] 38

[a] Includes manufactures of zinc.

Zinc imported for consumption in the United States, 1919–1924

Year	Blocks or pigs		Sheets		Old		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1919	32	$2,284	1	$249	37	$2,216	52	$5,753	$1,258	$11,760
1920	[a]	17	4	614	14	1,065	17	6,207	1,746	9,649
1921	6,598	559,870	6,688	496,445	6	341	42	1,121	8,290	1,066,067
1922	40	3,327	416	59,037	46	2,403	79	5,614	9,517	79,898
1923	1	375	[a]	41	20	1,624	4	891	16,331	19,262
1924	11	1,973	[a]	88	14	1,493	59	9,241	20,089	32,884

[a] Less than a ton.

General imports into the United States of old brass fit only for remanufacture, 1919–1924

[Average composition about one-third zinc and two-thirds copper]

Year	Short tons	Value	Year	Short tons	Value
1919	7,938	$2,157,948	1922	71,962	$10,985,308
1920	22,355	5,174,885	1923	20,395	3,992,917
1921	20,449	2,373,082	1924	4,636	698,022

No American zinc has been returned from abroad since 1921. The quantities so returned in the period September, 1920, to March, 1921, are given by months in the chapter on zinc in Mineral Resources, 1921. The tariff of 1922 has a paragraph on the return of United States products, which provides that to be admitted free of duty they must be imported by or for the account of the person who exported them from the United States.

General imports of zinc ore into the United States, 1919–1924, in short tons

Year	Canada		Mexico		Other countries		Total	
	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content
1919	10,656	3,878	33,443	11,225	4,550	1,906	48,649	17,009
1920	4,731	1,794	47,453	14,975	13,589	5,718	65,773	22,487
1921	1,471	554	6,050	2,147	18	4	7,539	2,705
1922	[a]	235	[a]	1,665	[a]	29	[a]	1,929
1923	[a]	4	[a]	3,201	[a]	18	[a]	3,223
1924			[a]	4,649			[a]	4,649

[a] Gross weight not recorded.

The sources of the zinc ore imported from "Other countries" in 1919–1920 are given in the chapter on zinc in Mineral Resources, 1920, Part I, page 232.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1919–1924

Year	Zinc ore		Pigs or slabs		Plates and sheets		Zinc dross		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919			109,746	$17,524,153	19,762	$5,212,002	5,123	$739,295	[a]	[a]
1920			74,046	12,495,144	11,852	2,832,993	2,445	316,637	[a]	[a]
1921			1,753	204,984	1,816	425,618	510	45,340	[a]	[a]
1922	1,695	$33,592	26,815	2,994,625	3,217	574,491	8,412	662,080	1,998	$287,890
1923	[b] 2,804	[b]	42,131	5,961,525	3,732	764,369	[c] 14,745	[c] 1,221,986	3,679	507,289
1924	[b] 368	[b]	[d] 72,583	[d] 9,538,459	3,658	784,728	[c] 10,845	[c] 974,179	2,270	353,867

[a] Figures not available prior to 1922.
[b] Not separately enumerated by Bureau of Foreign and Domestic Commerce after 1922, but included with "Zinc dross;" Canadian smelters report imports of 2,804 tons of zinc ore and concentrates from the United States in 1923; exporters from the Joplin district report 368 tons of concentrates shipped to Belgian smelters in 1924.
[c] Exports of zinc ore and dross are lumped together, these figures include the quantity and value of zinc ore exported as shown in the first column.
[d] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

Domestic brass and brass manufactures exported from the United States, 1919–1924

[Zinc content approximately 30 per cent by weight]

Year	Bars, plates, and sheets		Scrap and old		Articles made from brass	Total value
	Short tons	Value	Short tons	Value		
1919	3,885	$2,310,561	661	$176,028	$11,426,289	$13,912,878
1920	2,905	1,671,608	1,030	254,189	13,202,854	15,128,651
1921	1,437	741,110	2,969	405,871	7,123,366	8,270,347
1922	1,830	635,449	3,147	514,322	7,675,979	8,825,750
1923	1,733	703,503	6,587	1,198,560	6,917,901	8,819,964
1924	2,265	740,993	29,294	5,352,197	6,299,046	12,392,236

Foreign zinc exported from the United States, 1919–1924

Year	Exported from warehouse			Exported in manufactures with benefit of drawback, slabs and sheets excluded (short tons)
	Blocks, pigs, and old		All other manufactures	
	Short tons	Value		
1919	12,256	$1,943,507	$13,071	4,533
1920	28,132	4,331,636		237
1921	1,256	100,677	10,785	130
1922	3,471	429,122	30,227	1,298
1923	7,080	941,257	[a]	
1924	[b]	[b]	[a]	

[a] Not given separately.
[b] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

Domestic and foreign zinc exported from the United States, 1923–24, by destinations

[Figures in parentheses are not duplicated in the totals]

Destination	Domestic [a]				Foreign (slabs)	
	Slabs [a]		Sheets			
	Short tons	Value	Short tons	Value	Short tons	Value
1923						
Africa			4	$817		
Asia	72	$10,817	285	57,538	6	$966
China			(73)	(13,935)	(6)	(966)
Japan	(1)	(253)	(131)	(25,804)		
Philippine Islands			(67)	(13,366)		
Australia and Oceania	10	2,134	67	23,622		
Canada	326	56,007	908	170,341	[b]	105
Cuba	3	583	323	63,883		
Europe	41,438	5,848,293	1,010	225,960	7,069	939,383
Belgium	(1,008)	(156,129)	[b]	(59)		
France	(5,117)	(747,079)	(136)	(26,751)	(1,064)	(144,939)
Great Britain	(31,694)	(4,427,563)	(709)	(167,622)	(5,893)	(780,459)
Italy	(1,171)	(169,197)	(113)	(14,462)	(112)	(13,985)
Spain	(174)	(26,655)	(15)	(5,150)		
Mexico	189	28,400	480	90,783	4	719
Panama	3	483	28	5,318		
South America	86	14,125	375	78,917	1	84
Argentina	(55)	(8,961)	(89)	(19,505)		
Brazil	(6)	(1,039)	(135)	(26,010)		
Chile	(25)	(3,943)	(11)	(2,413)		
Colombia	[b]	(87)	(87)	(16,402)		
Ecuador			(13)	(3,262)		
Peru	[b]	(67)	(21)	(6,339)	(1)	(84)
Other countries	4	683	252	47,190		
	42,131	5,961,525	3,732	764,369	7,080	941,257
1924						
Africa			5	1,327		
Asia	1,685	226,147	270	62,662		
China	[b]	(37)	(23)	(7,079)		
Japan	(1,223)	(167,446)	(186)	(40,834)		
Philippine Islands	(9)	(1,587)	(45)	(9,740)		
Australia and Oceania	28	3,807	43	14,726		
Canada	547	80,552	1,007	186,414		
Cuba	36	4,262	468	89,278		
Europe	69,374	9,086,598	994	242,597		
Belgium	(2,647)	(363,775)				
France	(10,835)	(1,486,598)	(59)	(12,602)		
Great Britain	(44,541)	(5,672,995)	(858)	(207,059)		
Italy	(5,589)	(760,272)	[b]	(183)	[c]	[c]
Spain	(129)	(19,158)	(13)	(3,851)		
Mexico	376	61,947	265	56,704		
Panama	15	2,200	38	7,160		
South America	515	71,787	454	99,946		
Argentina	(381)	(52,642)	(280)	(58,505)		
Brazil	(88)	(12,110)	(65)	(13,869)		
Chile	(43)	(6,575)	(10)	(3,011)		
Colombia	[b]	(119)	(50)	(10,991)		
Ecuador			(1)	(455)		
Peru	(2)	(330)	(13)	(4,212)		
Other countries	7	1,159	114	23,914		
	72,583	9,538,459	3,658	784,728		

[a] Exports of slab zinc made from foreign ore are not given separately for 1924, but have been included with domestic exports.

[b] Less than a ton.

CONSUMPTION

APPARENT CONSUMPTION OF PRIMARY SLAB ZINC

Primary zinc consumed in the United States, 1919–1924, in short tons

	1919	1920	1921	1922	1923	1924
Supply:						
Stock Jan. 1—						
In bonded warehouse				131	80	80
At smelters	41,241	36,793	71,037	70,321	16,810	27,808
Production	465,743	463,377	200,500	354,277	510,434	517,339
Imports, foreign	70	15	6,739	52	21	25
Imports, domestic, returned		8,162	731			
Total available	507,054	508,347	279,007	424,781	527,345	545,252
Withdrawn:						
Exports, foreign, from warehouse	12,256	28,132	1,256	3,471	7,080	[a]
Exports, foreign, under drawback	4,533	237	130	1,298		
Exports, domestic	129,508	85,898	3,569	30,032	45,863	[a]76,241
Stock, Dec. 31—						
In bonded warehouse			131	80	80	
At smelters	36,793	71,037	70,321	16,810	27,808	20,754
Total withdrawn	183,090	185,304	75,407	51,691	80,831	96,995
Apparent consumption	323,964	323,043	203,600	373,090	446,514	448,257

[a] Foreign exports included under domestic exports.

CONSUMPTION OF SLAB ZINC IN HOT GALVANIZING

Statistics of the output, by the hot process, of galvanized sheets, galvanized formed products made from iron or steel sheets, and galvanized wrought-iron and steel pipe are gathered by the American Iron and Steel Institute from all the manufacturers of these products and are published yearly. Other classes of galvanized products, such as wire, barbed wire, cast and forged products, and nails, spikes, and bolts are not taken into statistical account by the Institute. As described on pages 1071–1072 of Mineral Resources for 1918, Part I, a fairly close estimate can be formed of the quantity of zinc used in coating these reported products, and, though it represents only a part of the total zinc consumed in galvanizing, a comparison of the yearly figures gives a good idea of the relative condition of the galvanizing industry. Statistics for the principal other galvanized products are given in the following table:

Galvanized sheets, pipe, etc., produced in the United States and zinc used in galvanizing them, 1919–1924, in short tons

	1919	1920	1921	1922	1923	1924
Galvanized iron and steel sheets [a]	750,288	935,680	683,442	1,054,996	1,182,431	1,114,480
Galvanized formed products [a] [b]	70,247	71,947	54,978	82,857	82,871	77,951
Galvanized pipe [a]	300,335	355,397	299,106	436,957	512,865	508,501
	1,120,870	1,363,024	1,037,526	1,574,810	1,778,167	1,700,932
Zinc used (estimated) [c]	134,500	163,500	124,500	189,000	213,000	204,000

[a] From annual statistical reports of American Iron and Steel Institute.
[b] Articles formed or stamped from iron or steel sheets and galvanized after shaping.
[c] Estimated as indicated above.

CONSUMPTION OF SLAB ZINC BY USES

The largest use of slab zinc is in galvanizing, but another large use is in making brass, and a considerable quantity is rolled into sheet zinc. For a number of years the quantity of slab zinc thus consumed has been estimated by W. R. Ingalls, formerly in the Engineering and Mining Journal and recently in the Yearbook of the American Bureau of Metal Statistics. The estimates for a few years are given below.

Estimated consumption of slab zinc in the United States by uses, 1919–1924, in short tons

	Galvanizing	Brass-making	Sheet zinc	Other purposes[a]	Total
1919	163,000	155,000	55,000	29,000	402,000
1920	192,000	144,000	53,200	35,000	424,200
1921	138,100	75,000	30,400	19,000	262,500
1922	205,400	145,000	53,500	36,000	439,900
1923	235,200	175,000	55,800	49,000	515,000
1924	240,000	178,000	61,000	56,000	535,000

[a] Includes zinc used for the manufacture of French oxide, lithopone, atomized zinc dust, die castings, slush castings, and for the desilverization of lead.

PRICES AND VALUE

The fluctuations in the quoted price of the prime western grade of zinc at St. Louis are illustrated in Figure 6, which shows graphically for the year 1924 the relations of the average weekly St. Louis quoted price of zinc, the weekly average London price of zinc, the weekly average price of 60 per cent zinc blende concentrates at Joplin, Mo., and the weekly sales of concentrates in the Joplin region as a whole. The price of zinc has been taken from market reports; the price of zinc blende and the figures of weekly sales are those published in the Joplin daily papers. To eliminate the sharp weekly fluctuations, and to obtain a curve more easily comparable with the price curves, the weekly sales have been averaged by months, the result being shown by the broken line.

The price of prime western zinc at the beginning of the year in the St. Louis market was 6.275 cents but it rose to 6.925 cents by the middle of February and then declined gently to 5.65 cents by the latter part of May. A very gradual rise, becoming more pronounced in the last quarter, carried the price to 7.825 cents at the end of the year. The average quoted price a pound for prime western zinc for immediate delivery at St. Louis in 1924 was 6.3 cents, as compared with 6.7 cents in 1923, and with 5.7 cents in 1922.

The London average quotation for the year was £33 12s. per long ton, as compared with £32 18s. 6d. in 1923, as shown in "Metal Statistics", 1925, published by the American Metal Market Co., of New York. The graphs of New York and London prices are closely parallel, the London price being the higher—from one-tenth to one-half cent a pound.

A canvass of the sales of zinc and the amounts received by producers in 1924 gives 6.5 cents a pound as the average selling price of all grades. This is the figure used in calculating the value of the zinc output of the country.

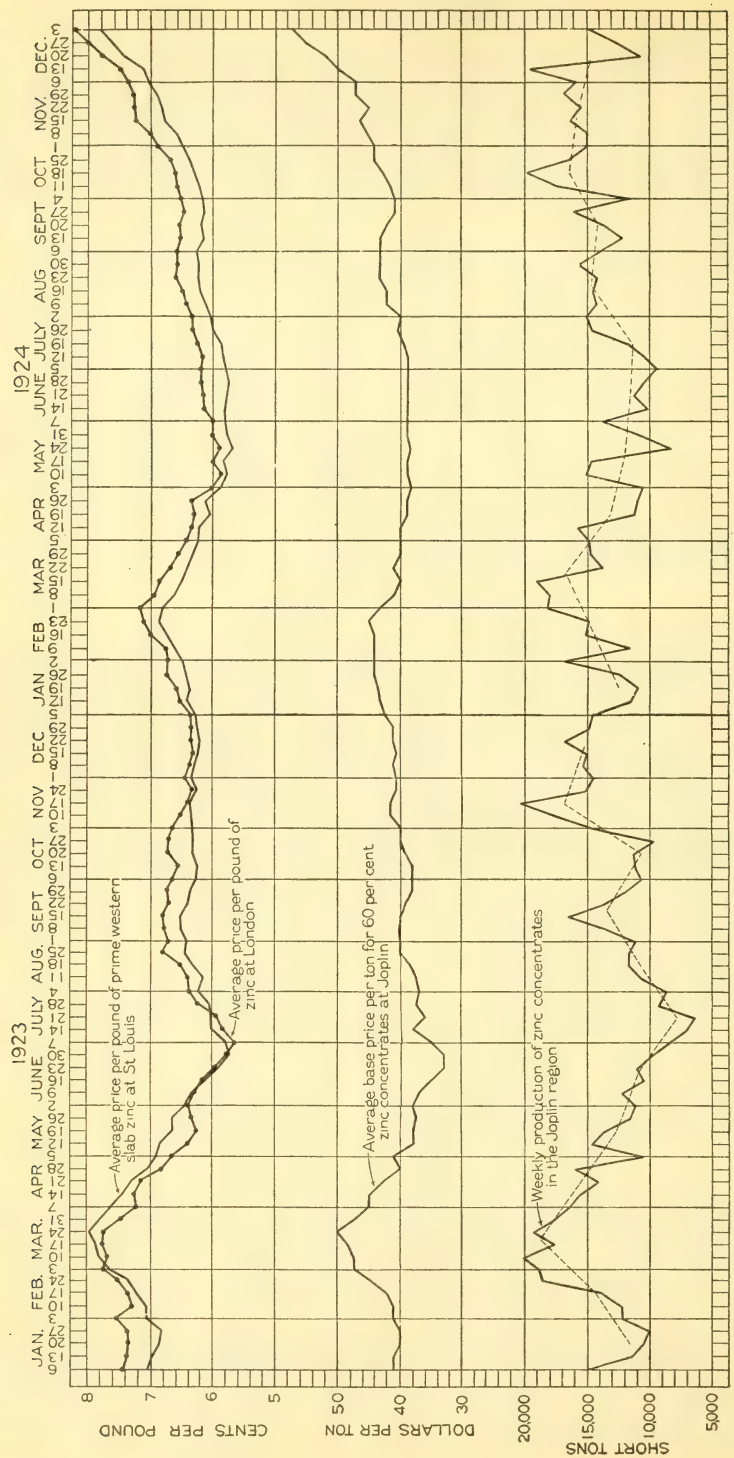
1923
1924
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT OCT NOV DEC. JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC.
Average price per pound of prime western slab zinc at St Louis
Average price per pound of zinc at London
Average base price per ton for 60 per cent zinc concentrates at Joplin
Weekly production of zinc concentrates in the Joplin region
CENTS PER POUND
DOLLARS PER TON
SHORT TONS
8
7
6
5
50
40
30
20,000
15,000
10,000
5,000

FIGURE 6.—Average weekly quoted price of zinc at St. Louis and London and of 60 per cent concentrates at Joplin, and weekly "production" (sales) of zinc concentrates in the Joplin region, 1923–24

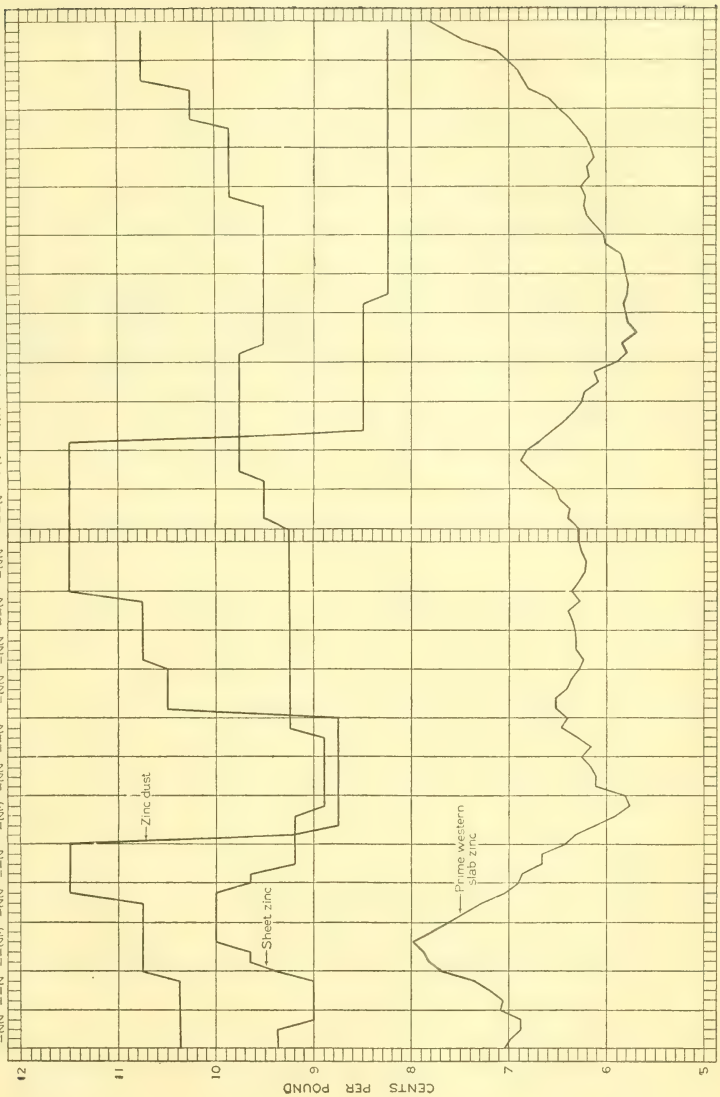

FIGURE 7.—Relation of prices of metallic zinc products to the price of prime western zinc at St Louis, 1923-24

Average price of zinc, by grades, 1919–1924, in cents per pound

	1919	1920	1921	1922	1923	1924
Grade A (high grade)	8.3	8.4	5.6	6.0	7.1	6.8
Grade B (intermediate)	7.7	8.3	5.5	6.0	7.1	6.8
Grade C (select and brass special)	7.2	8.2	4.9	5.6	6.7	6.4
Grade D (prime western)	7.1	8.0	4.9	5.6	6.7	6.4
All grades	7.3	8.1	5.0	5.7	6.8	6.5
Prime western, average spot quotation at St. Louis	7.0	7.8	4.7	5.7	6.7	6.3

Distilled and electrolytic zinc produced in the United States, 1919–1924

Year	Domestic primary		Foreign primary		Redistilled secondary		Total	
	Short tons	Value [a]	Short tons	Value [a]	Short tons	Value [a]	Short tons	Value [a]
1919	452,272	$66,032,000	13,471	$1,967,000	19,748	$2,883,000	485,491	$70,882,000
1920	450,045	72,907,000	13,332	2,160,000	21,371	3,462,000	484,748	78,529,000
1921	198,232	19,823,000	2,268	227,000	17,573	1,757,000	218,073	21,807,000
1922	353,274	40,273,000	1,003	114,000	32,988	3,761,000	387,265	44,148,000
1923	508,335	69,134,000	2,099	285,000	39,434	5,363,000	549,868	74,782,000
1924	515,831	67,058,000	1,508	196,000	35,486	4,613,000	552,825	71,867,000

[a] Value based on the average selling price for all grades.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By C. N. Gerry

PRODUCTION

SUMMARY

The value of the mine production of gold, silver, copper, lead, and zinc in Idaho in 1924 was 2 per cent greater than in 1923, because of a large increase in the value of lead. The decrease in gold, copper, and zinc was pronounced, and silver increased in quantity but not in value. Although the value of the metal output has gradually increased since 1921, when it was unusually low, it did not reach the average annual value for the decade 1915 to 1924, which was $31,000,000. Since 1863, Idaho has yielded an output of the five metals valued at nearly $791,000,000; lead supplied the largest part. Dividends for 1924, mostly taken from the annual printed reports of the companies but partly estimated, amounted to $4,602,000.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1924

	Number of producers	Ore, tailings, and slag	Gold •	Silver •	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	220	1,711,988	$556,523	7,793,154	2,738,824	248,950,292	15,340,498	$27,049,877
Increase or decrease from 1923	−11	−51,532	−210,904	+119,492	−1,240,807	+6,594,559	−12,612,251	+539,353
Total, 1863–1924	------	------	135,183,699	274,413,354	140,249,468	7,383,605,468	477,742,748	790,998,629

• Includes placer production.

Tables printed in the 1922 report give the source of the different metals by kinds of ore and by years from 1911 to 1922. During that period 87 per cent of the gold was derived from dry and siliceous ore and from placers. About 80 per cent of both the silver and lead came from lead ore and most of the remainder from lead-zinc ore and zinc ore.

ORE

The quantity of ore, tailings, and slag sold or treated in Idaho in 1924 decreased 3 per cent and was only 62 per cent of that for 1917, the banner year. Of the total, 73 per cent was lead ore and 23 per cent lead-zinc ore; siliceous ore represented 1 per cent; copper ore, 2 per cent; and copper-lead ore and copper-zinc ore less than 1 per cent. These ores had the following average values in metals per ton: Dry gold ore, $6.66; dry gold and silver ore, $82.41; dry silver ore,

$23.19; copper ore, $17.51; lead ore, $16.03; copper-lead ore, $36.40; lead-zinc ore, $14.20; and copper-zinc ore, $5.92. Most of the dry and siliceous ore was treated by amalgamation. The first-class shipping ore—71,382 tons—was largely lead ore and copper ore; its average recoverable content as shipped is given on page 263.

Most of the copper ore, lead ore, copper-lead ore, and lead-zinc ore was milled; the results are presented in the table on page 262.

Ore and metals produced in Idaho in 1924

Source	Number of producers	Ore, tailings, and slag		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	39	17,886	1.04	5,646.12	20.97	3,614	0.05
Dry gold and silver ore	3	17		30.86	.11	1,121	.01
Dry silver ore	10	1,357	.08	131.45	.49	42,402	.54
Copper ore	8	37,634	2.20	2,407.47	8.94	504,644	6.48
Lead ore	78	1,254,212	73.26	1,061.00	3.94	5,815,764	74.63
Copper-lead ore	1	3,962	.23	12.21	.05	140,423	1.80
Lead-zinc ore	6	396,420	23.16	308.45	1.15	1,278,942	16.41
Copper-zinc ore	1	500	.03	.14		1,996	.03
Total deep mines		1,711,988	100.00	9,597.70	35.65	7,788,906	99.95
Total placers	79			17,324.10	64.35	4,248	.05
		1,711,988		26,921.80	100.00	7,793,154	100.00

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	63		370			
Dry gold and silver ore	90					
Dry silver ore	1,006	0.04	2,716			
Copper ore	1,989,050	72.63	131,204	0.05		
Lead ore	672,154	24.54	201,074,111	80.77	151,453	0.99
Copper-lead ore	53,387	1.95	536,356	.22		
Lead-zinc ore	21,658	.79	47,204,467	18.96	15,168,313	98.88
Copper-zinc ore	1,416	.05	1,068		20,732	.13
	2,738,824	100.00	248,950,292	100.00	15,340,498	100.00

GOLD ORE

Most of the gold ore came from the Gold Hill & Iowa property in Boise County, and the Unity property, near Warren, in Idaho County. In past years the mines of Elmore, Idaho, and Lemhi Counties were large producers of gold ore, but the high cost of mining and transportation difficulties have prevented outlays for development. The gold ore averaged $6.53 in gold and 0.20 ounce of silver to the ton.

Dry gold ore sold or treated in Idaho in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ada	6	8.31	3		
Boise	14,187	3,577.53	732		
Camas	37	20.25	24	16	282
Custer	65	43.91	15		
Elmore	260	93.90	40		
Gem	4	4.26	2		
Idaho	2,429	1,561.91	1,005		
Lemhi	229	97.70	34		
Owyhee	266	132.92	1,720	36	
Shoshone	3	1.06	2	11	88
Valley	400	104.37	37		
	17,886	5,646.12	3,614	63	370

GOLD AND SILVER ORE

Mines in Owyhee and Custer Counties shipped several small lots of gold and silver ore, which averaged $37.53 in gold and 65.94 ounces of silver to the ton.

SILVER ORE

Silver ore was mined chiefly in Owyhee County at the Flint mine south of Silver City and at the Edna mine in Boise County. Bonner County produces considerable copper ore carrying so much silver that it is often considered a silver ore. The silver ore of the State as a whole averaged $2 in gold and 31.25 ounces of silver to the ton, as well as a small quantity of copper and lead.

Dry silver ore sold or treated in Idaho in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Boise	60	2.69	659		
Bonner	11	.60	2,557	279	462
Butte	16		205		774
Kootenai	4	.21	456	30	179
Lemhi	1		38		
Owyhee	1,265	127.95	38,487	697	1,301
	1,357	131.45	42,402	1,006	2,716

COPPER ORE

Copper ore was mined in Bonner, Custer, and Lemhi Counties chiefly; most of it was milled. Copper ore from Lemhi and Custer Counties decreased materially, but there was a notable increase in the copper from ore mined in Bonner County. A milling plant was erected for the Idaho Metals Co. near Mackay. The total output of copper ore in the State averaged $1.32 in gold and 13.41 ounces of silver to the ton and contained 2.64 per cent of copper and 0.17 per cent of lead.

Copper ore sold or treated in Idaho in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Bonner	17,865	1,120.00	483,615	221,046	131,204
Custer	11,775	1,244.92	18,808	1,137,771	
Latah	27	.54	19	8,431	
Lemhi	7,967	42.01	2,202	621,802	
	37,634	2,407.47	504,644	1,989,050	131,204

LEAD ORE

Most of the lead ore, the most valuable mine product of Idaho, was milling ore from Shoshone County. Boundary, Lemhi, and Custer Counties also produced and shipped lead ore in quantity. The Bunker Hill & Sullivan property at Kellogg, in Shoshone County, was the leading producer, and the Continental mine in Boundary County led the mines in the other counties. The average content of all lead ores was 4.64 ounces of silver to the ton, 0.03 per cent of copper, and 8.02 per cent of lead.

Lead ore sold or treated in Idaho in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Bear Lake	7		5		5,632	
Blaine	1,802	132.71	98,833	5,259	821,297	
Bonner	1,504	9.62	9,867	217	15,382	
Boundary	34,955		100,465		4,634,984	
Butte	1,447	2.37	15,226	1,178	559,007	
Camas	33	43.79	688	332	6,424	
Cassia	18	11.65	269	162	18,488	
Custer	3,531	49.52	78,031	17,563	1,069,587	
Lemhi	10,258	316.92	96,394	13,228	4,488,077	
Shoshone	1,200,657	494.42	5,415,986	634,215	189,455,233	151,453
	1,254,212	1,061.00	5,815,764	672,154	201,074,111	151,453

COPPER-LEAD ORE AND COPPER-ZINC ORE

Some of the milling ore from Custer County contained enough copper to be classed as a copper-lead ore. It averaged 35.44 ounces of silver to the ton, 0.67 per cent of copper, and 6.77 per cent of lead.

Ore mainly carrying copper and zinc but containing a little lead was treated experimentally in Adams County and a few lots of copper concentrate and zinc concentrate were shipped.

ZINC ORE AND LEAD-ZINC ORE

No zinc ore was sold in 1924, but the output of lead-zinc ore was considerable. Four mines in Shoshone County and one in Blaine County yielded the lead-zinc ore, all of which was concentrated; it averaged 3.23 ounces of silver to the ton, 5.95 per cent of lead, and 1.91 per cent of zinc. The following table gives the kind and grade of zinc material shipped in 1921 to 1924:

Zinc ore, lead-zinc ore, and concentrates (as marketed from Idaho mines and mills) sold to smelters, 1921–1924

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrate	Recovered zinc
1921		*Short tons*	*Pounds*	*Per cent*	*Pounds*
Sulphide zinc ore	Shoshone	72	39,368	27.34	33,463
1922					
Oxidized zinc ore	Adams and Blaine	84	57,387	34.16	43,321
Zinc concentrates	Shoshone	4,911	4,795,070	48.82	4,065,810
		4,995	4,852,457	48.57	4,109,131
1923					
Sulphide lead-zinc ore	do	387	336,338	43.45	285,888
Zinc and lead-zinc concentrates	do	33,942	32,965,845	48.56	27,666,861
		34,329	33,302,183	48.50	27,952,749
1924					
Zinc and lead-zinc concentrates	Adams, Blaine, and Shoshone.	23,176	18,733,995	40.42	15,340,498

GOLD

The mine production of gold in Idaho in 1924 decreased 27 per cent and was decidedly lower than the yearly output for the decade 1915 to 1924, which was about $737,000. The gold output from Idaho was decreasing steadily before 1920, but dredges in Elmore and Shoshone Counties brought the output up to normal in 1923. In 1924, however, the gold from both deep and placer mines decreased. The deep mines produced $198,402 in gold and the placers $358,121, of which $340,462 was won by dredges. The three main sources of gold—lead ore, siliceous ore, and placers—all showed a smaller yield. The production of gold from mills using amalgamation and cyanidation decreased slightly to 5,486.04 ounces. This quantity was more than 20 per cent of the total gold output. Concentrates of all kinds contained nearly 8 per cent of the total gold, and crude ore shipped to smelters contained about 7.5 per cent of it. Since 1897 gold worth $5,408,749 has been recovered by dredges.

In 1924 only six mines had a gold output of more than $20,000 each—those of the South Park Dredging Co. at Featherville, the Yukon Gold Co. at Murray, the Gold Hill & Iowa Mines Co. at Quartzburg, the Idaho Metals Co. at Mackay, the Talache Mines Co. in Bonner County, and the Unity mine at Warren.

SILVER

In 1924 the mine production of silver in Idaho increased less than 2 per cent in quantity and was still decidedly less than the yearly average of the decade 1915 to 1924, which was about 8,580,000 ounces. The output of silver in Shoshone County increased 578,209 ounces, but the output from Bonner, Blaine, Custer, and Lemhi Counties was smaller.

Concentrates yielded more than 82 per cent of the silver, shipping ore 17 per cent, and placer bullion and gold and silver bullion from deep mines less than 1 per cent.

Seven mines—the Morning, the Bunker Hill & Sullivan, Hercules, Hecla, Tamarack & Custer, Talache, and Gold Hunter—produced more than 300,000 ounces of silver each. Other large producers of silver were the Sunshine, Ramshorn, Caledonia, Success, and Idaho-Continental mines.

COPPER

The mine production of copper decreased 31 per cent in quantity. The average yearly output for the decade 1915 to 1924 was about 4,717,000 pounds, but during the last five years it has been less than 2,850,000 pounds. Shoshone County showed a small increase, but Lemhi, Custer, and Bonner Counties showed decided declines. Copper from Lemhi County, which ranked second in production in 1923, decreased 52 per cent. The largest producers of copper in the State were the Idaho Metals Co. at Mackay, the Pope Shenon mine near Salmon, the Hercules mine at Burke, and the Talache mine in Bonner County. Crude shipping ore of all kinds furnished 44 per cent and concentrates 56 per cent of the copper.

LEAD

In 1924 the mine production of lead increased 3 per cent in quantity and 17 per cent in value. The average price of lead increased from 7 cents a pound in 1923 to 8 cents in 1924. Shoshone County supplied 95 per cent of the total output, and Boundary, Lemhi, and Custer Counties made a good production. Concentrates of all kinds yielded 86 per cent and crude ore shipped 14 per cent of the total.

Ten mines produced more than 1,000,000 pounds of lead each in 1924. Three of them—the Bunker Hill, Morning, and Hecla—yielded more than 35,000,000 pounds each; the other large producers were the Hercules, Tamarack & Custer, Gold Hunter, Idaho-Continental, Latest Out, Success, Nabob, Mace, Stratton, Caledonia, Constitution, Hayes, Ramshorn, and Frisco mines.

ZINC

The mine production of zinc amounted to 15,340,498 pounds, a decrease of 45 per cent from the output of 1923, though the average price of zinc in 1924 was only slightly lower than in 1923. The Callahan Lead-Zinc Co., formerly the largest producer of zinc in the State, shipped no zinc ore in 1924. All the zinc concentrates, except a few lots from Blaine and Adams Counties, came from the Coeur d'Alene region, where the largest producers were the Morning, Success, Constitution, Nabob, and Tamarack & Custer mines. There was some activity in the development of lead-zinc ore in the Highland Surprise, Nabob, Constitution, and Sidney mines in the Pine Creek region, as well as in the Star mine near Mullan.

MINING INDUSTRY

During 1924 the mining industry of Idaho was notably free from conditions that prevent successful operation. The high price of lead and a fair price for silver caused marked activity at the large mines of the Coeur d'Alene region, which pay most of the dividends

declared by mining companies of the State. The increase of 1 cent a pound in the average price of lead not only increased the gross average price of a ton of silver-lead concentrate $7, but caused decidedly larger expenditures for development and equipment. Although the Hercules mine was worked out after being a large producer for 24 years and the Callahan Zinc-Lead Co. made no shipments in 1924, activity at smelting and refining plants increased, and much money was expended in improvements. The increase of the ore reserves at the Bunker Hill & Sullivan, Hecla, Morning, Tamarack & Custer, and Star properties was noteworthy, and the successful development of the Galena, Ajax, Ambergris, and many of the newer mines was most encouraging. The output of gold, copper, and zinc was not what it had been, but at the close of the year the outlook for these metals was brighter than for several years.

METALLURGIC INDUSTRY

In Idaho 53 milling plants of all kinds were active in 1924, against 48 in 1923. Of these mills 35 were concentration plants, 20 of which used flotation machines with other concentrating devices, 5 used flotation alone, and 10 used crushers, jigs, and tables, without flotation cells; 15 used amalgamation alone, and 3 used cyanidation. Several mills were in course of construction and others were remodeled.

Only 1 per cent of the ore—17,673 tons—was treated in gold and silver mills, and gold and silver recovered from this ore by amalgamation and cyanidation were valued at $115,213, or $6.52 per ton of ore treated. Nearly all the gold in bullion was won by amalgamation. The mills purchased 320 pounds of quicksilver and used 950 pounds of sodium cyanide in 1924. The average amount of quicksilver purchased was 0.018 pound per ton of ore amalgamated and 0.044 pound per ounce of gold and silver bullion saved. The consumption of cyanide was 1.05 pounds per ounce of gold and silver recovered.

Gold and silver produced at mills in Idaho in 1924, by counties

County	Ore (short tons)	Bullion (fine ounces) recovered from ore by—				Total value
		Amalgamation		Cyanidation		
		Gold	Silver	Gold	Silver	
Ada	6	8.31	3			$174
Boise	• 14,247	3,472.64	665	75.54	691	74,257
Camas	17	10.80	4			226
Custer	68	46.12	72			1,001
Elmore	260	.31		93.59	40	1,968
Gem	4	4.26	2			89
Idaho	2,429	1,559.41	1,005	2.50		32,961
Lemhi	229	97.70	34			2,043
Owyhee	12	10.08	130			295
Valley	401	104.78	50			2,199
	17,673	5,314.41	1,965	171.63	731	115,213

• Also yielded 1 ton of siliceous concentrate.

Of the total ore and tailings 95 per cent was concentrated. Metals in concentrates from the ore, from 33,544 tons of old tailings, and from ore treated in gold and silver mills were valued at $85.81 a ton, against $79.77 in 1923. The concentrates came largely from the Coeur d'Alene region, and the ratio was 6.14 tons of ore and tailings to 1 ton of concentrate. Most of the total was lead concentrate and lead-zinc concentrate, each of which increased greatly. Only a few shipments of zinc concentrate were marketed. Operators in Shoshone County shipped an average of 21,262 tons of concentrates of various kinds a month, against 20,634 tons in 1923. This amount, with the crude ore shipped (4,118 tons a month), gives the Coeur d'Alene region an average monthly output of 25,380 tons of concentrates and crude ore, against 26,557 tons in 1923. The average value of metals in the lead concentrate increased from $80.15 to $87.16 a ton. The copper concentrate and the copper-lead concentrate were especially valuable for their high silver content.

Mine production of metals from Idaho concentrates in 1924

By counties

	Ore to concentrating mills[a]	Concentrates	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Adams	500	39	0.13	1,996	1,416	1,068	20,732	$2,958
Blaine	464	147	15.92	4,161	457	46,332	12,149	7,674
Boise		1	32.04	35				686
Bonner	19,365	1,885	1,129.44	493,309	221,263	143,998		394,371
Boundary	34,903	3,749		99,194		4,580,478		432,898
Butte	1,117	267	.58	3,340	464	274,313		24,256
Camas	20	4	9.45	20	16	282		233
Custer	7,572	1,406	65.96	154,747	106,148	930,102		193,358
Lemhi	9,870	1,606	27.20	6,897	610,698	252,050		105,348
Owyhee	1,448	27	148.15	23,834	402	1,206		19,182
Shoshone	1,512,557	255,145	661.25	5,625,726	596,194	207,993,743	15,307,617	21,495,500
	1,587,816	264,276	2,090.12	6,413,259	1,537,058	214,223,572	15,340,498	22,676,464

By kinds of concentrates

Dry and siliceous	32	189.64	23,889	418	1,488			20,100
Copper	3,404	1,185.20	487,697	883,570	132,272			477,588
Lead	236,934	625.38	5,598,047	599,574	210,115,034			20,651,367
Zinc	193	7.50	2,785	109	10,141	184,334		14,828
Copper-lead	730	12.20	140,423	53,387	536,356			144,238
Lead-zinc	22,983	70.20	160,418		3,428,281	15,156,164		1,368,343

Average recoverable content

		Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Dry and siliceous	32	5.93	746.53	0.65	2.32		628.13
Copper	3,404	.35	143.27	12.98	1.94		140.30
Lead	236,934		23.63	.13	44.34		87.16
Zinc	193	.04	14.43	.03	2.63	47.75	76.83
Copper-lead	730	.02	192.36	3.66	36.74		197.59
Lead-zinc	22,983		6.98		7.46	32.97	59.54
	264,276	.01	24.27	.29	40.53	2.90	85.81

[a] Also 33,544 tons of old tailings milled.

Of the total ore 4 per cent was shipped crude to smelters; most of it, and the concentrates, was treated at Bradley, Idaho; East Helena and Great Falls, Mont.; Selby, Calif.; and near Salt Lake City, Utah. The total value of the metals in first-class ore was $3,865,562 as compared with $4,816,065 in 1923. Of the crude ore shipped 85 per cent was lead ore; the remainder was largely copper ore. Most of the ore smelted was sulphide, though 15 per cent of the lead ore was carbonate. The combined value of the metals in concentrates and crude shipping ore was $26,542,026.

Mine production of metals from Idaho crude ore shipped to smelters in 1924

By counties

	Ore	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Bear Lake	7		5		5,632	$454
Blaine	1,338	130.71	94,916	4,980	780,763	129,409
Bonner	15	.78	2,730	279	3,050	2,126
Boundary	52		1,271		54,506	5,213
Butte	346	1.79	12,091	714	285,468	31,069
Camas	33	43.79	688	332	6,424	1,924
Cassia	18	11.65	269	162	18,488	1,921
Custer	11,684	1,240.32	79,083	1,101,551	669,538	276,492
Kootenai	4	.21	456	30	179	327
Latah	27	.54	19	8,431		1,128
Lemhi	8,356	331.73	91,737	24,332	4,236,027	410,391
Owyhee	84	130.90	17,294	421	95	14,356
Shoshone	49,418	128.74	1,056,648	59,512	28,404,262	2,990,752
	71,382	2,021.16	1,357,207	1,200,744	34,464,432	3,865,562

By kinds of ore

Dry and siliceous	119	132.77	20,552	741	1,598	16,740
Copper	10,239	1,222.40	18,542	1,106,896		182,695
Lead	61,024	665.99	1,318,113	93,107	34,462,834	3,666,127

Average recoverable content

		Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	
Dry and siliceous	119	1.12	172.70	0.31	0.67	140.67
Copper:						
Oxidized	512	.10	3.17	5.04		17.39
Sulphide	9,727	.12	1.74	5.42		17.87
Lead:						
Oxidized	9,235	.03	11.47	.08	24.36	47.53
Sulphide	51,789	.01	23.41	.08	28.93	62.31
	71,382	.03	19.01	.84	24.14	54.15

PRODUCTION BY COUNTIES

GENERAL FEATURES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1924

County	Gold					Silver *	
	Placers		Deep mines		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Ada	22.98	$475	8.32	$172	$647	7	$5
Adams	21.91	453	.15	3	456	2,001	1,341
Bear Lake						5	3
Bingham	11.17	231			231	1	1
Blaine			146.63	3,031	3,031	99,077	66,382
Boise	122.82	2,539	3,580.24	74,010	76,549	1,418	950
Bonner			1,130.23	23,364	23,364	496,039	332,346
Bonneville	14.51	300			300		
Boundary						100,465	67,312
Butte			2.37	49	49	15,431	10,339
Camas	7.98	165	64.05	1,324	1,489	714	478
Cassia			11.66	241	241	269	180
Clearwater	42.13	871			871	7	5
Custer	40.20	831	1,352.76	27,964	28,795	237,341	159,018
Elmore	8,728.30	180,430	93.90	1,941	182,371	3,005	2,013
Gem			4.26	88	88	2	1
Idaho	238.54	4,931	1,561.88	32,287	37,218	1,047	701
Jerome	7.59	157			157		
Kootenai			.19	4	4	456	306
Latah	28.69	593	.53	11	604	20	13
Lemhi	191.42	3,957	456.61	9,439	13,396	98,697	66,127
Owyhee	1.60	33	289.13	5,977	6,010	41,268	27,650
Power	2.13	44			44		
Shoshone	7,811.89	161,486	790.01	16,331	177,817	6,695,830	4,486,206
Twin Falls	8.61	178			178		
Valley	9.34	193	104.78	2,166	2,359	52	35
Washington	12.29	254			254	2	1
Total, 1923	17,324.10	358,121	9,597.70	198,402	556,523	7,793,154	5,221,413
	24,125.05	498,709	12,999.23	268,718	767,427	7,673,662	6,292,403

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$652
Adams	1,416	$186	1,068	$85	20,732	$1,347	3,415
Bear Lake			5,632	451			454
Bingham							232
Blaine	5,437	712	827,095	66,168	12,149	790	137,083
Boise							77,499
Bonner	221,542	29,022	147,048	11,764			396,496
Bonneville							300
Boundary			4,634,984	370,799			438,111
Butte	1,178	154	559,781	44,783			55,325
Camas	348	46	6,706	536			2,549
Cassia	162	21	18,488	1,479			1,921
Clearwater							876
Custer	1,208,721	158,342	1,605,943	128,475			474,630
Elmore							184,384
Gem							89
Idaho							37,919
Jerome							157
Kootenai	30	4	179	14			328
Latah	8,431	1,104					1,721
Lemhi	635,030	83,189	4,488,077	359,046			521,758
Owyhee	823	108	1,301	104			33,872
Power							44
Shoshone	655,706	85,898	236,653,990	18,932,319	15,307,617	994,995	24,677,235
Twin Falls							178
Valley							2,394
Washington							255
Total, 1923	2,738,824	358,786	248,950,292	19,916,023	15,340,498	997,132	27,049,877
	3,979,631	585,006	242,355,733	16,964,901	27,952,749	1,900,787	26,510,524

* Includes placer production.

Ore sold or treated, deep mines producing, and average value of ore in Idaho, 1923–24, by counties

County	Ore, tailings, and slag sold or treated in 1924 (short tons)		Number of deep mines producing		Average total value per ton [a]		Average value per ton in gold and silver [a]	
	Total	Increase or decrease	1923	1924	1923	1924	1923	1924
Ada	6	−7	2	2	$30.08	$29.00	$30.08	$29.00
Adams	500	+192	2	1	7.85	5.92	5.13	2.68
Bear Lake	7	+7		1		64.86		.43
Blaine	2,602	−23,939	15	18	13.11	52.68	8.05	26.68
Boise	14,247	−5,333	10	12	4.60	5.26	4.43	5.26
Bonner	19,380	−27,888	9	6	15.12	20.46	12.80	18.35
Boundary	34,955	−25,075	2	1	6.25	12.53	1.31	1.93
Butte	1,463	+1,463		5		37.82		7.10
Camas	70	+60	2	5	42.60	34.04	42.60	25.73
Cassia	18	+18		1		106.72		23.39
Clark		−38	1		80.45		2.29	
Custer	19,336	−8,722	15	13	24.51	24.50	11.90	9.67
Elmore	260	−169	8	2	10.94	7.57	10.94	7.57
Gem	4	−17	2	2	103.95	22.25	101.67	22.25
Idaho	2,429	+1,808	8	7	25.72	13.57	25.72	13.57
Kootenai	4	+4		1		82.00		77.50
Latah	27	+27		1		41.74		.85
Lemhi	18,455	−24,945	17	18	15.20	28.06	2.75	4.09
Owyhee	1,544	+388	11	8	28.84	21.91	28.80	21.77
Shoshone	1,596,280	+61,269	38	35	15.02	15.36	3.29	2.82
Valley	401	−601	2	2	15.24	5.49	15.24	5.49
Washington		−34	2		31.32		27.62	
	1,711,988	−51,532	146	141	14.75	15.59	3.72	3.16

[a] Placer product excluded.

Number and production of producing placer mines in Idaho, 1923–24

County	1923						1924					
	Mines			Gold	Silver (fine ounces)	Total value	Mines			Gold	Silver (fine ounces)	Total value
	Hydraulic	Dredge	Drift				Hydraulic	Dredge	Drift			
Ada	2			$288	3	$290	1			$475	4	$478
Adams							2			453	5	456
Bingham	2			188		188	1			231	1	232
Boise	14			10,398	139	10,512	7			2,539	27	2,557
Bonneville	4			817	2	819	1			300		300
Camas							2			165	2	166
Canyon	1			53		53						
Clearwater	3	1		6,118	71	6,176	4			871	7	876
Custer	6	1		1,134	23	1,153	5			831	7	836
Elmore	5	1		221,593	3,676	224,608	2	1		180,430	2,965	182,417
Idaho	22			8,317	71	8,375	24		1	4,931	42	4,959
Jerome							2			157		157
Latah	3			848	3	850	3			593	1	594
Lemhi	8			3,986	18	4,001	8			3,957	29	3,976
Owyhee							2			33	10	40
Power							1			44		44
Shoshone	4	1		243,604	2,591	245,729	2	1	1	161,486	1,144	162,252
Twin Falls	1			162		162	4			178		178
Valley	5			881	16	894	3			193	2	194
Washington	1			322	3	324	1			254	2	255
	81	4		498,709	6,616	504,134	75	2	2	358,121	4,248	360,967

ADA COUNTY

Black Hornet district.—Small test lots of gold ore from the Sorrel Horse and Gold Bond properties near Boise were treated by amalgamation.

Highland district.—A little placer gold was saved from the banks of Boise River, especially at the Pick & Shovel claim.

ADAMS COUNTY

Meadows district.—Placer gold was produced from the Flat Rock and Briggs properties near New Meadows.

Seven Devils district.—The American Mining Co. worked the Azurite mine near Homestead, Oreg. Several lots of copper concentrate and zinc concentrate from the flotation plant were shipped to smelters in Utah and Texas. Development continued at the Red Ledge property of the Idaho Copper Co., where low-grade copper ore is opened by tunnels and diamond-drill holes. The management says that the reserves contain more than a million tons of ore carrying about 2 per cent of copper and a little gold and silver. A road is being built down Snake River to give railroad connection. The deposit was described in a bulletin[1] issued in 1920.

BEAR LAKE COUNTY

St. Charles district.—The Blackstone property near Paris shipped one small lot of lead ore.

BINGHAM COUNTY

A small quantity of placer gold was mined from the banks of Snake River.

BLAINE COUNTY

The output of Blaine County decreased $210,751, as the production of silver and lead from the Warm Springs and Mineral Hill districts was comparatively small, notwithstanding the large amount of work done in search of new ore bodies. The value of the output in 1924 was only about one-fifth of the value of the average annual output since 1880. From 1880 to 1924 Blaine County has produced $2,559,624 in gold, $16,247,002 in silver, $64,339 in copper, $8,878,103 in lead, and $650,372 in zinc, a total of $28,399,440. The quantities of the various metals follow: Gold, 123,823.57 fine ounces; silver, 17,761,912 fine ounces; copper, 367,682 pounds; lead, 199,398,237 pounds; and zinc, 8,027,360 pounds.

Mineral Hill district (Hailey).—Eleven deep mines in the Mineral Hill district produced 569 tons of ore which, with 800 tons of tailings, yielded $477 in gold, 12,157 ounces of silver, 866 pounds of copper, 113,654 pounds of lead, and 12,149 pounds of zinc, valued in all at $18,618, or $13.60 a ton. The output consisted of 464 tons of mill ore and 800 tons of old tailings concentrated, and 105 tons of first-class lead ore. The largest output was from the Minnie Moore

[1] Livingston, D. C., and Laney, F. B., The copper deposits of the Seven Devils and adjacent districts Idaho Bureau of Mines and Geology, Bull. 1, 1920

mine, where several lots of concentrate were jigged from dump ore. Several hundred tons of old tailings from the Red Cloud property were re-treated, yielding a lead and a zinc concentrate. Small lots of ore were shipped from the Eureka, Arizona, Idaho, Jack Dempsey, Jennie R., Wolftone, and Star properties. After doing considerable development by tunnels, 1,845 feet of which were driven in 1924, the Bunker Hill & Sullivan Mining & Concentrating Co. of Kellogg relinquished its lease on the Bullion-Mayflower-Red Elephant group. The Federal Mining & Smelting Co., stopped work on the Minnie Moore mine after sinking the Allen shaft to the 800-foot level and turned the lease and bond over to Harold Boericke, of Philadelphia, Pa., under whose management prospecting was continued. Early in 1925 mill ore was said to have been discovered beyond the Wood River fault.

Warm Springs district (*Ketchum*).—Seven deep mines in the Warm Springs district produced 1,233 tons of ore, yielding $2,554 in gold, 86,920 ounces of silver, 4,571 pounds of copper, and 713,441 pounds of lead, valued in all at $118,465, or $96.08 a ton. All the ore was shipped directly to smelting plants in Utah. The marked decrease in the district's output, which was valued at $343,036 in 1923, was due to the fact that the Independence mine, owned by the Federal Mining & Smelting Co., was not operated on company account. Lessees, however, shipped several hundred tons of sulphide lead ore containing much silver. The North Star property, under the same management, was not productive, as no economical means of treating the ore was devised. Considerable carbon associated with the lead and zinc minerals made a clean separation by flotation impossible. Several lots of oxidized lead ore containing considerable zinc were shipped from the Homestake mine to the lead plant at Murray, Utah, and development during the year consisted of 900 feet of work in various tunnels. The Boyle Mountain, Rocky Bar, West Fork, and Wellington claims shipped small lots of lead ore. A new concentration mill designed to treat 150 tons of ore a day was in course of erection at the Hailey Bonanza mine, which is being developed; 500 feet of tunnel work was done at the Mascot mine.

BOISE COUNTY

The value of the output of Boise County decreased from $100,639 to $77,499. The placer production was small, though much money was spent in hydraulic equipment, and the output of the Gold Hill & Iowa property was decidedly less than in preceding years.

Banner district.—Silver ore was treated by cyanidation in the 25-ton mill at the Edna property east of Idaho City. The mine is developed by a 350-foot shaft, 200 feet of drifts, and a tunnel 1,100 feet long.

Bodie or Payette River district.—Several tons of free-milling gold ore from the Lost mine north of Horseshoe Bend were treated by amalgamation.

Boise Basin district.—The output of the Boise Basin district from 9 deep mines and 7 placers consisted of 14,175 tons of ore, $76,246 in gold, and 752 ounces of silver, valued together at $76,750. The ore had an average value of $5.23 in metals a ton; the placer output

was $2,539 in gold and 27 ounces of silver. A large quantity of rather low-grade ore was treated at the Gold Hill & Iowa property near Quartzburg by amalgamation, concentration, and cyanidation; nearly all the gold was recovered by amalgamation.

The property was operated the entire year under lease to the El Cerro del Oro Co., but the output was considerably less than in 1923, as work was on a one-shift basis. The mine, one of the oldest producers in Idaho, is rather extensively developed by drifts and tunnels, but the shaft is only 600 feet deep. Ore was also treated by amalgamation at the Mammoth, Mountain Chief, Missouri, Liberty, and Hayfork properties. The Idawa Gold Mining Co., which is developing the Belshazzar mine, constructed a 25-ton amalgamation and concentration mill. Extensive development work was done at the Washington-Subrosa group by the Monetary Metals Co. The Golden Age Junior Mining Co. unwatered its mine and continued to install machinery in its new flotation mill. No dredges were operated in the district, though the Gold Dredging & Power Corporation plans to dredge ground at Centerville; there were no large hydraulic operations, but placer gold was shipped from the National, Lexington, Swede Gulch, and other claims near Idaho City.

Summit Flat district.—The Black Jack mine east of Pioneerville produced a small quantity of gold ore which was treated by amalgamation. The mill at the Olympia mine was idle, but the tunnel was extended.

BONNER COUNTY

The output of Bonner County decreased $318,358 in 1924, but the mining districts around Lake Pend Oreille contributed a large part of the State output. The most interesting development was at the Talache Mines (Inc.), where ore from the lowest levels has decidedly increased the value of the mill product.

Lakeview district.—The Venzwela group was worked by the Hewer Mining Co., and several hundred tons of ore containing lead but valuable primarily for silver were treated in a 100-ton flotation mill. As much time was spent in development work and in erecting the mill, which was moved from the Loon Lake mine in Washington the plant was operated for production only 30 days. It is estimated that at least 30,000 tons of milling ore are developed, the minerals being galena, sphalerite, pyrite, tetrahedrite, siderite, and quartz. The mine is opened by 1,500 feet of drifts and tunnels, and considerable drifting and raising were done in 1924. The main ore shoot, said to be 10 feet wide, has been followed on the adit level for 275 feet. A short summary[2] of conditions at the property was published in August.

Pend d'Oreille district.—Five deep mines in the Pend d'Oreille district produced 17,880 tons of ore yielding $23,169 in gold, 486,345 ounces of silver, 221,325 pounds of copper, and 134,254 pounds of lead, valued in all at $388,754, or $21.74 a ton. The district output decreased from $712,543 in 1923. Most of the output was from the property of the Talache Mines (Inc.), at which a 150-ton concentration-flotation mill was busy 11 months. The con-

[2] Hewer Mining Co. finishes new 100-ton flotation mill: Eng. and Min. Jour.-Press, vol. 118, Aug. 23, 1924, p. 308.

centrate, which contained an unusually large amount of silver, was shipped to East Helena, Mont., and Tacoma, Wash. The mine is opened by 26,419 feet of tunnels, drifts, raises, crosscuts, and inclines, and more than 5,000 feet of work was done in 1924. The striking feature in the development is that the silver content of the vein has increased materially at greater depth. The ore recently cut on the 1,200 and 1,300 foot levels contains considerable polybasite as well as tetrahedrite and native silver. Small lots of ore were shipped from the Elsie K. and Blanket Lead and some silver ore from the Blue Bird and Silver Hill claims.

BONNEVILLE COUNTY

The American and Clemens Bar claims, near Gray, in the Mount Pisgah district yielded a little placer gold.

BOUNDARY COUNTY

The value of the output of Boundary County increased $62,855, due to the increase in lead from the Idaho Continental mine near Port Hill. At several gold properties, notably the Cynide mine, development work was in progress but no production recorded.

Moyie Yahk district.—The Cynide Gold Mining Co. completed its dam, hydroelectric plant, and transmission line, and continued to install machinery for the new cyanidation mill. The Idaho Gold & Ruby Co., which had made large expenditures for equipment for hydraulic operations, was in the hands of a receiver; a reorganization was planned late in the year.

Port Hill district (Klockmann).—Several thousand tons of silver-lead concentrate were shipped from the Idaho-Continental mine, 26 miles west of Port Hill. Shipments can not be made continuously, as the road is impassable part of the year, but the output was larger than that of any other lead mine outside of Shoshone County. According to press reports a large new ore body was opened, but later work showed it to be part of the original vein.

BUTTE COUNTY

The output of Butte County in 1924 was valued at $55,325. It resulted from resumption of shipments from the Wilbert mine. No output was made in 1923.

Antelope district.—One lot of lead ore was shipped from the Lead Belt mine near Mackay, operated by the Needles Mining Co.

Dome district.—Other than a small test lot of lead ore from the Great Western property, the entire output of the Dome district came from the Wilbert mine near Howe, and 43 miles from Arco, the shipping point. Several hundred tons of first-class lead ore were shipped from the Wilbert property, formerly a large producer, and ore was also milled in the new 20-ton concentration plant erected in 1924. The mine is opened by a tunnel 1,500 feet long.

Lava Creek district.—A test lot of silver-lead ore was shipped from the Creek group near Martin.

CAMAS COUNTY

Little Smoky district.—Three deep mines and one placer in the Little Smoky district produced 52 tons of ore, $1,187 in gold, 129 ounces of silver, 226 pounds of copper, and 2,885 pounds of lead, valued in all at $1,534. The ore had an average value of $26.60 in metals a ton. The Crystal Gold placer on the South Fork of the Boise River near Fairfield made a small output. Gold ore from the Home Guard property was treated by amalgamation, a little ore from the Liberty mine was concentrated, and some rich lead ore containing considerable gold was shipped directly from the Five Points property.

Rosetta district.—The Blue Bird mine shipped one lot of silver-lead ore.

Skeleton Creek district.—A test lot of gold ore from the Snow Slide prospect 30 miles north of Fairfield was treated by amalgamation.

CASSIA COUNTY

Stokes district.—The Independence & Flagstaff property near Declo shipped one lot of sulphide lead ore containing silver.

CLEARWATER COUNTY

Moose Creek district.—At the Dodo Amended property a little placer gold was recovered by sluicing ancient river gravel.

Pierce district.—Two placers in the Pierce district produced $412 in gold and 4 ounces of silver, a marked decrease from the output of past years. The Hay Creek placer was worked a short time by hydraulic mining.

CUSTER COUNTY

The metal output of Custer County decreased from $688,991 to $474,630, though there was considerable activity in development and mill building at Clayton and Mackay. The output was more valuable than that of any county but Shoshone and Lemhi, and the county was first in the production of copper.

Alder Creek district (Mackay).—Six deep mines in the Alder Creek district produced 12,744 tons of ore yielding $26,059 in gold, 27,631 ounces of silver, 1,140,694 pounds of copper, and 323,622 pounds of lead, valued in all at $219,892, or $17.25 a ton. The decrease of 35 per cent in value of the district's output was caused by the decreased quantity of copper ore shipped. Most of the output was first-class copper ore and lead ore from the vicinity of White Knob, but part of it was copper ore milled in the new concentration plant of the Idaho Metals Co. near Mackay.

This company, which operates the old Empire property, has been a steady producer of copper ore containing gold and silver since 1903, and though the output decreased in 1924 the mine was the largest producer of copper in Idaho. Both oxidized and sulphide ore were shipped to Salt Lake City for smelting, and toward the end of the year concentrate from the new 150-ton flotation mill was also being marketed. A fire at the surface plant in July prevented shipments for three months, after which the product was sent to International, Utah. Monthly shipments were greatly increased early in 1925. Several hundred tons of oxidized lead ore were shipped from the

Homestake mine, controlled by the United States Smelting, Refining & Mining Co., and several lots of similar material from the Bluebird, Horsehoe, and Speculator properties. A few lots of sulphide ore and concentrates were marketed from the Doughboy mine.

Bayhorse district.—The output of the Bayhorse district consisted of lead ore and copper-lead ore produced at the Red Bird and Ramshorn properties. The Red Bird mine near Clayton was worked under lease by Robert N. Bell, who shipped considerable jig concentrate to International, Utah. In December this property was bonded by the Ford Motor Co., which started extensive operations in road building and development work. The Ramshorn mine was worked the entire year, and the 50-ton flotation plant was active from May to September. The output consisted of several hundred tons of first-class lead ore, together with copper-lead concentrate containing considerable silver. The ore is mainly valuable for silver, which occurs largely in tetrahedrite.

Boulder district.—The Livingston mine, 15 miles south of Clayton, yielded several lots of first-class silver-lead ore. Considerable work was done in road building and the construction of a tramway, power plant, and 300-ton concentration-flotation plant.

Stanley Basin district.—Placer mining in the Stanley Basin district yielded $373 in gold and 4 ounces of silver. The Challis & Sturkey placer in Kelley Gulch was worked by hydraulic mining.

Yankee Fork district.—Four deep mines and 2 placers in the Yankee Fork district produced 73 tons of ore, $1,435 in gold, 561 ounces of silver, 89 pounds of copper, and 2,574 pounds of lead, valued at $2,028 in all. The ore had an average value of $21.48 in metals a ton. One small lot of silver-lead ore was shipped from the Silver Queen property, and several lots of gold ore from the Snowdrift, Whynot, and Custer Slide properties were treated by amalgamation.

ELMORE COUNTY

Dredge operations near Featherville resulted in a large production, mainly gold, but the total value of the output for the county was about 20 per cent less than in 1923. Some of the old producing mines at Atlanta were retimbered, but no ore was milled.

Bear Creek district.—The large dredge of the South Park Dredging Co. near Featherville was busy throughout the year. The amount of gold produced was large though somewhat less than in 1923; it was shipped to the refinery at Selby, Calif. The company treated more than 1,600,000 cubic yards of gravel and was the largest producer of gold in Idaho in 1924.

Middle Boise district.—A little placer gold was saved by rocker from the banks of Middle Boise River near Atlanta. The deep mines of the district, large producers of both gold and silver from 1906 to 1917, were idle.

Neal district.—Several hundred tons of gold ore from the Homestake mine, near Mayfield, a large gold producer in 1911, were treated by cyanidation.

GEM COUNTY

West View district.—Though the mines near Pearl were idle, several test lots of ore from the Lincoln and North Basque properties were treated by amalgamation.

IDAHO COUNTY

The output of Idaho County, which has been comparatively small in recent years, was valued at $37,919. Development and operation of the mines has been delayed by lack of transportation facilities. The geology and ore deposits of the region were described at length in a bulletin [3] issued in 1924.

Camp Howard district.—A little placer gold was mined from the bars of Salmon River near Riggins.

Clearwater district.—The Cove placers near Grangeville yielded a little placer gold.

Dixie district.—Free-milling gold ore from the L. & L. claim was treated in an arrastre, and placer gold was recovered from the banks of Salmon River. A new stamp mill was built at the Dixie Royal mine, which is developed by 650 feet of drifts and tunnels and is said to have a large quantity of $20 gold ore in reserve.

Elk City district.—Five placers in the Elk City district yielded $319 in gold and 2 ounces of silver, valued together at $320. The output, which is decidedly less than in former years, came mainly from the Red Horse, Deadwood, and Spike Quartz placers.

Florence district.—The Submarine Gold Placer & Quartz Mining Co. is said to have started placer operations, but no output was reported.

Lolo district.—Placer gold in small quantity was mined from the bank of Salmon River near Kooskia.

Maggie Creek district.—The Discovery placer and other property on Bridge Creek produced a little placer gold.

Marshall Lake district.—The Sherman Extension property yielded rich free-milling gold ore, and several lots of bullion were sold to the assay office at Boise.

Newsome district.—The Moose Creek placer, 9 miles from Newsome, produced a small quantity of placer gold.

Orogrande district.—Development work at the Center Star and other property near Orogrande was said to have been encouraging, but no bullion was marketed other than that from experimental work at the Crooked River mine, where a large cyanidation plant is being constructed by the Orogrande Gold Mining Co.

Simpson district.—The largest production in the Simpson district was placer gold from the Danley group on the west fork of Salmon River. At the McKinley mine low-grade gold ore was mined but not treated, and several tons of high-grade material was shipped by parcel post early in 1925.

Warren district.—In the Warren district 4 deep mines and 5 placers yielded 2,068 tons of ore, $26,758 in gold, and 879 ounces of silver, valued together at $27,347. The ore had an average value of $11.69 in metals a ton. Most of the placer gold came from the Golden Rule property near Burgdorf and the Buck Diggings near Warren. The Little Giant mine, 48 miles north of McCall, the nearest railroad station, was operated by the Unity Gold Mines Co., which shipped considerable gold bullion from the 10-stamp amalgamation mill to the assay office at Boise. As repairing of the flume was neces-

[3] Thomson, F. A., and Ballard, S. M., Geology and gold resources of north central Idaho: Idaho Bureau of Mines and Geology, Bull. 7, 1924.

sary, the mine was working only about six months. A little free-milling gold ore was treated at the Gayety Mountain and Minnehaha properties.

JEROME COUNTY

A little placer gold was taken from the banks of the Snake River, near Jerome and Hazleton.

KOOTENAI COUNTY

A small lot of silver ore was shipped from the Silver King group west of Bayview. The greater part of the Lakeview district is in Bonner County, but the Silver King group extends west into Kootenai County.

LATAH COUNTY

Hoodoo district.—The output consisted of one lot of sulphide copper ore from the Mizpah mine near Harvard and placer gold from the Amy and Liberty claims on the north fork of Palouse River. The Mizpah (formerly the Merger mine) has considerable copper ore in reserve, but as it is 17 miles from the nearest railroad station and the ore is medium grade the profit is small after haulage, freight, and treatment charges are paid.

LEMHI COUNTY

The value of the metal output of Lemhi County decreased $142,090 in 1924 in consequence of fewer shipments of copper ore and lead ore from near Salmon and Gilmore. Since 1901 the year of largest returns from the county was 1912, when shipments of lead ore and dredge operations contributed to an output valued at $1,221,048. The United States Geological Survey has published a bulletin[4] on the copper deposits of Lemhi County.

Eldorado district.—The Harmony Mines Co. operated its 200-ton concentration-flotation mill, 8 miles southeast of Baker, part of the year and shipped several hundred tons of copper concentrate to International, Utah. Development of the 800-foot tunnel was continued, but the output of copper was only about one-seventh that of 1923.

Eureka district.—Ore was milled at the Pope Shenon mine by lessees and at the Tormey property, both south of Salmon. Copper concentrates were shipped to International, Utah, from the Pope Shenon mine, though the lease was relinquished and shipments ceased in June. The Eureka district extends 10 miles north of Salmon, near Moose Creek, and also south of Salmon in the Lemhi Range.

Indian Creek district (Ulysses).—The Ulysses mine was not operated regularly, but a little bullion from former work was marketed.

Junction district.—Several small lots of oxidized copper ore and lead ore were shipped from the Digmore property, in Jokes Canyon, near Leadore. The Leadore Mines Co. reported the development of

[4] Ross, C. P., The copper deposits near Salmon, Idaho: U. S. Geol. Survey Bull. 774, 1925, 44 pp.

much low-grade lead ore and was planning to improve the 50-ton concentration mill.

McDevitt district.—Several lots of sulphide copper ore from the Copper Queen property near Tendoy were smelted at Anaconda, Mont. The ore carries considerable gold, part of which is free.

Mackinaw district (Leesburg).—Four placers in the Mackinaw district yielded $3,317 in gold and 20 ounces of silver, valued together at $3,330. The output came mainly from the Hockensmith placer, on Arnett Creek, worked by hydraulic mining. A large hydraulic plant was being installed for the Leesburg Gold Placers Co., which owns claims on Napias Creek, northeast of Leesburg.

Mineral Hill district.—A little placer gold was marketed from the Boulder Creek and Fool Hen properties on Boulder Creek, and one lot of gold ore from the Grubstake mine was treated by amalgamation in a custom mill.

Nicholia district.—Some ore from the Viola mine, which was a large producer of carbonate lead ore in 1886, was treated by jigs. The concentrate was shipped to the lead plant at Murray, Utah. Prospecting disclosed some lead-zinc ore in the form of cerussite and calamine.

Pratt Creek district.—The Goldstone mine near Baker produced gold ore which was treated by amalgamation. The mill is equipped with tables, but no concentrate was marketed.

Spring Mountain district.—Several lots of lead ore from the Iron Mask and Red Warrior properties were treated in the custom milling plant owned by the Idaho Minerals Co. Concentrate was shipped from Gilmore, Idaho, to Murray, Utah.

Texas district (Gilmore).—Four deep mines in the Texas district produced 9,941 tons of ore, yielding $6,489 in gold, 94,881 ounces of silver, 12,703 pounds of copper, and 4,394,417 pounds of lead, valued in all at $423,276, or $42.58 a ton. Most of the output—8,276 tons—was first-class smelting ore and the remainder—1,665 tons—was concentrated. Although the value of the output decreased from $448,124 in 1923, ore of better grade was mined in 1924. The most noteworthy operations in the district were those of the Latest Out Mining & Smelting Co., which shipped several thousand tons of first-class oxidized lead ore and did 2,000 feet of development work. The property, consisting of one patented claim, has been a steady producer since 1910 and is said to have 25,000 tons of 25 per cent lead ore in reserve. Production was below normal at the Pittsburg-Idaho property, formerly the largest producer of the district, but lead ore and concentrate from the 25-ton mill were shipped to the smelter at Midvale, Utah; 2,118 feet of development work was done under the direction of a receiver. Several lots of crude ore and concentrate were shipped from the Gilmore property, owned by the Gilmore Mercantile Co.

Unorganized (Reno) district.—One lot of oxidized lead ore was shipped from the Cabin mine.

Yellow Jacket district.—The Gold Chain property near Forney yielded a little placer gold. No work was done at the old Yellow Jacket mine, formerly a large producer of gold.

OWYHEE COUNTY

The metal output of Owyhee County in 1924 was valued at $33,872, an increase of $533. From 1863 to 1924 the county produced gold valued at $21,680,710 and 24,570,980 ounces of silver, or a value for both metals of $40,637,673.

Carson district (Silver City).—Six deep mines and one placer in the Carson district yielded 331 tons of ore, $4,619 in gold, 17,953 ounces of silver, 331 pounds of copper, and 95 pounds of lead, valued in all at $16,699. The ore had an average value of $50.38 in metals a ton. The bulk of the output was concentrated, but the most valuable part was 71 tons of first-class ore shipped for smelting. The Trade Dollar mine was worked by the Florida Mountain Mines Co., which shipped several lots of silver ore containing some gold to Murray, Utah. Ore from the Never Sweat mine was treated in a 35-ton concentration-flotation plant which was used mainly for experimental purposes. Development work consisted of 1,400 feet of drifting, and operation on a large scale is planned. One lot of gold ore was shipped from the Gold Bug property, which is developed by 1,000 feet of drifts and tunnel. At the Great Western mine 800 feet of tunneling was done.

Flint district.—Several hundred tons of silver ore were milled at the Flint mine by the Precious Metal Mines Co., and 21 small lots of exceptionally rich silver concentrate were shipped to Midvale, Utah. The property is extensively developed, and the mill was repaired and improved in 1924. One lot of gold and silver ore was shipped from the Nellie Ann property.

French district.—Development was continued by the Red Jacket Gold Mining Co., which erected a 20-ton mill equipped for amalgamation and concentration.

POWER COUNTY

A little placer gold was saved from the banks of the Snake River, near American Falls.

SHOSHONE COUNTY

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, Idaho, in 1924

	Deep mines	Placers	Ore and tailings	Gold	Silver	Copper	Lead	Zinc	Total value
			Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	35	4	1,596,280	[a]$177,817	[a]6,695,830	655,706	236,653,990	15,307,617	$24,677,235
Increase or decrease from 1923	−3	−1	+61,269	−94,681	+578,209	+56,151	+7,801,452	−12,645,132	+1,379,688
Total, 1884–1924				6,923,217	207,242,655	74,807,742	[b]3,407,134	469,598,949	564,142,892

[a] Includes placer production of $161,486 in gold and 1,144 ounces of silver.
[b] Short tons.

The value of the metal output of Shoshone County, which comprises the Coeur d'Alene region, was $1,379,688 more than in 1923; the gain was due to the increased output and higher price of lead. The average total value of the ore from deep mines in 1924 was $15.36

in metals a ton, and the value in gold and silver was $2.82 a ton. The kinds of ore (nearly all was lead ore and lead-zinc ore) and the contents of each kind have been given in the preceding tables. Most of the ore was milled and yielded 255,145 tons of concentrates averaging $84.25 a ton. Eighteen milling plants, with a combined daily capacity of approximately 6,500 tons, were active during the year. All but one of these mills were concentration plants with flotation equipment, and three were straight flotation mills without tables. The mining of silver-lead ore progressed profitably at most of the large mines, but there was a marked decrease in zinc and gold.

The geology and ore deposits of the region were described in a bulletin[5] of the Geological Survey issued in 1923. The annual report[6] of the mine inspector gives a detailed list of operating companies by counties, a comprehensive bibliography, and interesting notes on the progress of the active mines.

Beaver district.—The output of the Beaver district comprised one lot of lead ore and placer gold from Trail Gulch, where the Darnell and Lock & Irwin placers were operated. The placer gold is usually found in the form of dust or medium-size nuggets, but one nugget weighing more than 21 ounces was found at the Lock & Irwin ground in October.

The Callahan Zinc-Lead Co. at Sunset shipped only one small lot of lead ore. Since 1914 the company has been the largest producer of zinc in Idaho, as well as a large producer of lead. Extracts from the company's annual printed report for 1924 follow:

> As announced in our report for the preceding period, shipments from the Callahan mine were suspended on September 30, 1923. * * *
>
> In pursuance of our policy for the extensive development of the Callahan property, the No. 33 crosscut was completed to our south side line, a total distance of over 3,200 feet from the main tunnel. Its purpose was to ascertain the existence of veins paralleling the great Callahan vein, but the results obtained were negative. Coincident with this exploratory work to the south on the main tunnel level, the vein on the No. 12 (winze level) was thoroughly explored, but the ore was found to be too low in quantity and quality to be classified as commercial grade. With the exception of a few comparatively small blocks, the commercial ore bodies still available for extraction in the Callahan mine are all above the No. 6 level. The net recoverable value of the tonnage remaining in place below that level would be many times offset by the cost of maintaining the lower workings for an indefinite period. In order to conserve our financial resources, your management, therefore, decided to permit the water in these levels to rise and drain out through the No. 6 level, thus establishing a saving of about $30,000 per annum by eliminating the cost of pumping and maintaining those workings. Pending the further development of the Galena properties, the Callahan property has been placed in charge of caretakers, who will make occasional timber replacements in the upper workings as required to conserve that portion of the mine for the future. * * *
>
> The company continues in sound financial condition, with current assets (consisting almost wholly of cash and marketable investment bonds) at the end of the fiscal year amounting to $847,712.33, as against total current liabilities of only $12,411.61. * * *
>
> The company has no funded indebtedness, but notice has been received from the United States Treasury Department of additional income and excess profits tax assessments approximating $175,000 for the years prior to 1918. The Government's contentions are based on a new method of mining property valuations and a revision of the ore depletion schedules generally used heretofore. A final determination of our additional tax liability will be reached when the case has been reviewed on the appeal now pending. * * *

[5] Umpleby, J. B., and Jones, E. L., jr., Geology and ore deposits of Shoshone County, Idaho: U. S. Geol. Survey Bull. 732, 1923, 156 pp.

[6] Campbell, Stewart, Twenty-sixth annual report of the mining industry of Idaho, for 1924.

Negotiations, which have been in progress for more than six months, for the acquisition of the property of the Wallace Mining & Milling Co. have now reached a point where the transaction may be finally consummated before this report reaches our stockholders. The holdings under consideration consist of 21 claims containing approximately 400 acres adjoining our Galena property on the east. With the acquisition of the Wallace group, our Galena holdings will consist of approximately 1,030 acres, contiguous, and splendidly located for the economical treatment and transportation of our future output from that source. * * *

Notes regarding the Galena mine, owned by the Callahan Zinc-Lead Co., are given under Placer Center district.

Coeur d'Alene district.—The Yukon Gold Co. operated its large electrically driven steel dredge on Prichard Creek almost continuously. The company was the second largest producer of gold in Idaho; it shipped bullion to the refinery at Selby, Calif. The following statement is taken from the annual printed report of the company for 1924:

The dredge on the property of the Coeur d'Alene Mining Co., Prichard Creek, mined 1,271,460 cubic yards of gravel, which yielded $160,996, or an average of 12.7 cents per cubic yard. Costs, excluding depreciation, were $93,284, or 7.3 cents per cubic yard. The operating profit was $67,712.

Eagle district.—Several lots of sulphide lead ore were shipped from the Lead Crystals property near Prichard.

Evolution district.—Three mines in the Evolution district produced 22,729 tons of ore and old tailings yielding $176 in gold, 210,717 ounces of silver, 21,888 pounds of copper, and 1,256,714 pounds of lead, valued in all at $244,761, or $10.77 a ton. The output consisted of mill ore from the Yankee Boy mine, operated by the Sunshine Mining Co., first-class lead ore from the Western Union property, and old creek tailings from the Harr property west of Wallace. A 75-ton flotation plant profitably treated ore from the Sunshine property, and 530 feet of drifting, cross-cutting, and shaft sinking was done. The company has considerable silver-lead ore in reserve and shipped several hundred tons of lead concentrate, chiefly valuable for the silver which occurs mainly in tetrahedrite. The output of the Western Union mine was below normal, but late in the year the property was acquired by the Day interests, who are expected to develop it thoroughly. The main tunnel is nearly a mile long and the winze from this level was deepened. Slimes and tailings from the tailing dam near Osborne were either shipped directly to the Bunker Hill smelter or concentrated at the Sweeney mill.

Hunter district (Mullan).—Four deep mines in the Hunter district produced 444,425 tons of ore yielding $6,801 in gold, 1,847,017 ounces of silver, 33,440 pounds of copper, 61,130,269 pounds of lead, and 10,560,382 pounds of zinc, valued in all at $6,825,530, or $15.36 a ton. An increase of more than $1,000,000 was shown in the output of the district, although the value of the ore per ton was somewhat less. The output consisted of 24,007 tons of first-class ore and 420,418 tons of ore of milling grade which yielded 67,778 tons of concentrate. The Morning mine near Mullan, owned by the Federal Mining & Smelting Co., remained the largest producer; it was active throughout the year. Lead ore and concentrate were shipped to the smelter at East Helena, Mont., and lead-zinc concentrate to the electrolytic plant near Great Falls, Mont.

The property is opened to a depth of 1,850 feet below the 800-foot or main adit level, which has a length of 10,000 feet. After the first-

class lead ore is picked from the belt the remaining low-grade ore is treated in a 1,000-ton mill equipped for wet concentration and flotation. According to the figures of the county assessor, the mine produced 345,950 tons of ore which had a gross value of $5,703,793. The cost of betterment was $138,210, and the net profits were $1,027,173. A separate report was made to the county assessor for the Sheridan lease of the Morning mine. The output was 54,515 tons, which had a gross value of $338,666. The cost of extraction was $313,326, and the net profits were $25,326. The annual report of the company for 1924 gives the following data:

> The earnings of the Morning mine in the year 1924 amounted to $1,131,494.38, being an increase of $283,522.67 over the earnings of 1923. These earnings have been exceeded only in the year 1917, in the war-boom period.
>
> The volume of ore mined was 345,950 tons, the average metal content of which was lead, 9.4 per cent; silver, 4.4 ounces per ton; zinc, 4.7 per cent. This includes milling ore mined by leasers and purchased from them.
>
> The developed ore reserves at the end of the year amounted to 1,204,372 tons. Probable ore, based on the assumption that the ore shoot will continue to the 3,250 level, 600 feet below the present lowest level is estimated at 1,224,000 tons. The total developed and probable ore, therefore, amounts to 2,428,372 tons and represents seven years' production at the current rate.
>
> The explorations in the upper part of the mine have continued successfully, and the production from that area is now around 10,000 tons per month. * * *
>
> Since 1912 the mine has produced 4,023,149 tons of ore, and the net earnings have been $7,594,784.

The lead concentrate contained 1,389,877 ounces of silver and 55,398,000 pounds of lead, and the zinc concentrate 127,725 ounces of silver, 2,690,000 pounds of lead, and 13,200,000 pounds of zinc. In discussing the life of the Morning mine the annual report gives the depth at which some of the neighboring mines were exhausted. The Hercules mine has been bottomed 1,200 feet below the collar of the shaft, the Frisco mine 1,600 feet, and the Tiger-Poorman 2,200 feet below. No signs of exhaustion are shown in the Bunker Hill at 1,600 feet, the Hecla at 2,400 feet, and the Morning at 1,850 feet. The shafts were started at very different elevations, except those of the Hecla and Morning mines, and the Morning mine has been stoped for several hundred feet above the collar of the shaft, which is really a winze from the 800 level.

> About all we can say with any certainty, then, in regard to the Morning, is that it is a big, strong vein, averaging 12 feet in width, which shows no sign of coming exhaustion as yet. With increasing depth, it is proportionately approaching the point of termination, and has already reached a depth at which anxiety as to the future becomes justified * * *

The Federal Mining & Smelting Co. paid $840,000 in dividends from earnings from property in Idaho and from lead-zinc mines in Missouri, Kansas, and Oklahoma.

The Gold Hunter Mining & Smelting Co. operated its mine and mill near Mullan and shipped several thousand tons of lead concentrate to the Bunker Hill smelter at Bradley. The property has a 500-ton concentration-flotation plant and is opened by six tunnels, two shafts, and several miles of drifts and crosscuts. About 2,000 feet of development was done during the year. According to the figures given the county assessor, the company mined 104,633 tons of ore, which had a value of $690,396. The cost of mining was $382,292, the freight and treatment charge $262,699, and the net profits $45,434.

The Star mine, which is owned equally by the Bunker Hill and Hecla companies, was opened at depth by a long crosscut from the 2,000-foot level of the Hecla mine. After this crosscut was driven 9,000 feet (2,444 feet in 1924), the ore shoot was cut at a depth of 4,000 feet, and 800 feet of drifting was done. Lead-zinc ore was shipped to Kellogg for milling early in 1925. The Bunker Hill Co. made the following statement in its annual report for 1924:

> Development of the Star mine is progressing satisfactorily. Ore was encountered early in December, 1924, and milling of the ore taken out in the progress of development work is now being done satisfactorily in our South mill. The indications are that a high recovery of the metals, with a good separation of lead and zinc, can be obtained. As the systematic development of the Star mine proceeds, this tonnage will be increased, until by the end of the year, or sooner, it is possible our South mill will be running at full capacity on this Star mine product.

Several lots of lead ore were shipped from the Alice mine, east of Wallace, to the smelter at Bradley.

Lelande district (Burke, Mace, Frisco).—Seven deep mines in the Lelande district produced 451,901 tons of ore, yielding 2,328,990 ounces of silver, 339,825 pounds of copper, and 73,929,443 pounds of lead, valued in all at $7,519,295, or $16.64 a ton. The output was considerably increased and consisted of 438,311 tons of mill ore, which was reduced to 68,645 tons of concentrates, and 13,590 tons of first-class silver-lead ore. The largest producers of the district were the Hecla and Hercules mines at Burke; the Hecla ranked first in lead production.

The Hercules, now exhausted, yielded several thousand tons of first-class smelting ore which was shipped to East Helena, Mont., and a large quantity of low-grade lead ore, which was shipped to the 700-ton milling plant at Wallace. Since the earliest shipments in 1901 this mine has yielded more than 29,000,000 ounces of silver and 727,000,000 pounds of lead. It was bottomed at 1,200 feet below the No. 5 tunnel, which was 4,000 feet above sea level. The mine has been operated as a partnership since 1900, but recently a company was incorporated which will work adjoining property, including the Ambergris mine. According to the statement to the county assessor, 37,572 tons of crude ore and concentrate were shipped, which had a gross value of $3,567,469. The net profits were $1,448,941. Dividends paid in 1924 were estimated to be $500,000, or about $18,000,000 since the earliest payments.

Operations at the large, modern, reconstructed mine plant of the Hecla property at Burke began January 27. The former mine plant was destroyed by fire July 13, 1923. Ore was shipped directly to the mill until September 1, when the new sorting plant at the mine was operated and normal prefire production resumed. The mine is opened by a shaft and various drifts to a depth of 2,240 feet, and 6,372 feet of development work was done during the current year, largely on the 1,600 and 2,000 levels. It was estimated that at the end of December reserves of silver-lead ore amounted to 1,831,900 tons, exclusive of ore disclosed in the winze below the 2,000-foot level. According to the statement to the county assessor, 242,908 tons of ore and waste were mined, which had a gross value of $4,220,012. Betterments cost $439,023, and the net profits were $1,399,404. Surplus at the end of the year was $2,827,718; dividends amounted

to $1,000,000 in 1924, making a total of $12,105,000 since the earliest payments. The following notes are taken from the annual report for 1924:

> Our ore-sorting plant at the mine was placed in operation in September and brought ore production to the same rate as prevailed before the fire which destroyed the surface plant in July, 1923. * * *
>
> During the year a winze was sunk to the 2,400-foot level, 400 feet below the lowest point previously reached on the Hecla vein. At the lower level a crosscut was extended to the vein, and the vein was drifted on for 100 feet. A very substantial ore showing was disclosed of the same character as that on higher levels. We have stopped work on this level and have resumed sinking in the winze, which will be advanced to the 2,800-foot level.
>
> Work of raising on the Wide West vein has been started but not completed, and not enough work has been done to determine what tonnage of commercial ore can be expected from this vein.

Of the ore mined, 227,453 tons were milled, making 34,225 tons of concentrate which, with 7,590 tons of crude ore, were smelted and contained 1,106,398 ounces of silver and 39,763,267 pounds of lead. According to published reports, the production of the Hecla mine for 21 years was 603,509 tons of crude ore and concentrate, containing 17,053,290 ounces of silver, 594,762,596 pounds of lead, and 941,229 pounds of crude zinc.

Several hundred tons of first-class lead ore was shipped from the Marsh mine by lessees, and the Federal Mining & Smelting Co. also shipped first-class lead ore from both the Frisco and Mace mines. The report to the county assessor gave 679 tons of ore from the Frisco property, valued at $72,551, on which a net profit of $8,126 was realized.

The Ajax property at Burke made its initial shipments of first-class and mill ore in May. High-grade lead ore was shipped to the Bunker Hill smelter and several thousand tons of mill ore to the Sweeney mill. The property adjoins the Hercules mine on the east, is opened by a tunnel 6,000 feet long, and will probably be a regular producer when fully developed. A lawsuit with the Hercules company was averted by the purchase of the Wicket claim, which was said to have the apex of the Ajax vein.

Placer Center district (*Sunset*).—Four deep mines in the Placer Center district produced 165,979 tons of ore, yielding $2,590 in gold, 663,778 ounces of silver, 160,396 pounds of copper, 22,269,146 pounds of lead, and 2,245,283 pounds of zinc, valued in all at $2,395,808, or $14.43 a ton. Other than 3,925 tons of silver-lead ore smelted directly, the district output consisted of 162,054 tons of ore milled, which made 28,745 tons of concentrates. The Tamarack & Custer Consolidated Mining Co. operated its property the entire year and shipped considerable crude ore and concentrate to East Helena, Mont. The property is opened by a vertical shaft 726 feet deep and by several miles of drifts and tunnels.

Development work in 1924 consisted of 2,901 feet of drifting, 1,500 feet of crosscutting, and 245 feet of raises, the important work being the opening of the Mammoth tunnel through which ore is brought to the mill at Frisco instead of by the aerial tram from Sunset. This tunnel is 7,000 feet long and cuts two veins 1,200 feet below No. 5 tunnel and 800 feet below No. 6 tunnel. The ore contains considerable sphalerite as well as galena, and several lots of zinc concentrate were shipped to Black Eagle, Mont. According to the statement to

the county assessor, 25,082 tons of crude ore and concentrate were marketed that had a gross value of $1,669,154; betterments cost $207,773, and the net profit was $97,805. Dividends amounting to $300,000 were paid in 1924. The Success Mining Co. (Ltd.) worked the old Granite mine at Sunset and shipped considerable crude lead ore as well as lead concentrate and lead-zinc concentrate from the 200-ton concentration plant. The ore contains galena, sphalerite, and magnetite.

Prospecting for new ore embraced 2,250 feet of drifting and 833 feet of diamond drilling. Unwatering the mine and repairing the mill proved so expensive that the year's operations showed a loss and an assessment was levied in November. The McPhillips group was operated by the Stratton Mines Co., which shipped a fair production of sulphide lead ore to East Helena, Mont. This property, a new producer, is opened by 1,300 feet of drifts and crosscuts, most of which were driven in 1924. According to the statement to the county assessor, 841 tons of ore were mined, which had a value of $76,292. Betterments cost $6,394 and the net profit was $19,555. Ore from the California mine was treated by the California Leasing Co., but the results were not satisfactory, as the 50-ton mill was inefficient. The property was afterwards taken over by the Option Mining Co.

The development of the Galena property in Lake Gulch, owned by the Callahan Zinc-Lead Co., is meeting with considerable success. Development in 1924 comprised 5,000 feet of crosscuts and drifts. About 250,000 tons of silver-lead ore is said to be in reserve. The annual report of the company gives the following notes:

> The main working shaft is completed down to the 600 level, making a total depth of 600 feet below the collar. Stations have been cut on the 200, 400, and 600 levels.
>
> The drift to the west on the 600 level has been driven on the vein for a distance of 1,044 feet. At a point approximately 300 feet west of the station ore was disclosed and drifted on for a distance of 30 feet. A crosscut showed the ore at its widest point to be 8 feet in width. An average sample across 6 feet assayed 8.5 per cent lead and 5.8 ounces of silver. A sample across 18 inches of the better ore assayed 42.2 per cent lead and 26.4 ounces of silver. * * *
>
> The drift to the east on the 600 level has been driven a distance of 1,690 feet. At a point 750 feet in from the station ore was disclosed and followed for a distance of 350 feet, the ore being narrow and occurring in irregular bunches. * * *
>
> On the 200-foot winze level, at a depth of 800 feet below the collar of the main shaft, a small station was cut and a crosscut run to the south, disclosing the vein approximately 12 feet in width. Drifting to the west is in progress along the north wall of the vein, and at the time this report was written had advanced for a distance of 27 feet from the station. Each round the ore has shown a gradual improvement in grade, and an average sample taken across the face of the drift approximately 5½ feet in width assays 15.8 per cent lead and 11.6 ounces of silver. A specially picked sample of the high-grade ore assays 71.5 per cent lead and 65.6 ounces of silver.

St. Joe district.—At the head of the St. Joe River, 24 miles from Superior, Mont., hydraulic mining of the Golden Gate placer yielded a small quantity of unusually fine gold. No copper ore was shipped from the Richmond or the Monitor properties. At the Richmond mine the crosscut tunnel, 1,900 feet below the surface, was driven 1,200 feet to the vein, and 900 feet of drifting was done on the vein.

Summit district.—One lot of sulphide lead ore was shipped from the Bear Top mine east of Murray by the operator, the Northwestern Silver & Lead Corporation. The mine and surface plant were put

in working order and an electric power line constructed more than 3 miles to the 150-ton mill, which has been idle several years. Former producers, such as the Monarch and Paragon properties, were idle.

Yreka district (Kellogg).—Thirteen deep mines in the Yreka district produced 480,134 tons of ore which, with 31,024 tons of tailings, yielded $6,764 in gold, 1,643,464 ounces of silver, 100,157 pounds of copper, 77,994,566 pounds of lead, and 2,501,952 pounds of zinc, valued in all at $7,523,198, or $14.72 a ton. The output consisted of 472,774 tons of mill ore with 31,024 tons of old tailings reduced to 88,985 tons of concentrate, and 7,360 tons of first-class crude ore.

The value of the output was considerably increased and the grade of the ore was better. As in former years, the mines of the Yreka district yielded more lead than any other district in the State, but both the Lelande and Hunter districts produced more silver. The Bunker Hill & Sullivan Mining & Concentrating Co. operated its milling plants near Kellogg, as well as the custom plant at Sweeney. Nearly 7,000 tons a month of lead concentrate were shipped to the company's smelter at Bradley and to plants of the American Smelting & Refining Co. According to the statement for the county assessor, the company produced 422,907 tons of ore, which had a gross value of $6,816,876. Betterments cost $388,456 and net profit was $2,360,127. Dividends aggregated $1,962,000 in 1924, or a total of $30,834,000 paid since 1890. The balance at the end of the year was $8,855,588. The following notes are taken from the company's annual report for 1924:

> The mine yielded approximately the same tonnage as during the previous year; the grade, however, was slightly better, resulting in a substantially higher yield of lead and silver for 1924. This, with the better prices received for lead, returned an operating profit of more than $500,000 over that of the preceding year. The ore first cut a year ago on No. 17, then the lowest level of the mine, has since been steadily developed and is found to be as extensive as and equal in grade to the ore in the upper levels. Crosscutting on this same level to the Francis-Barr system of veins has disclosed ore of value, and drifting on such fissures is now under way. This latter development is of great importance, as no systematic development or stoping has been done on these fissures for several hundred feet of elevation above No. 17 level. Sinking of the main shaft has now reached No. 18 level, 1,800 feet vertically below the Kellogg adit tunnel, and as soon as the ore pockets, sumps, and cutting of station are completed crosscutting will be started for the ore bodies on this level.
>
> During the year a new 800-horsepower hoist was installed and placed in successful and economical operation and has a capacity to take care of all the requirements of the mine for many years to come. * * *
>
> The physical condition of the mines and of all departments of the plant is excellent. The demand for our product is the best, and the prices secured are the highest in years. There is a strong probability that such prices will be maintained, inasmuch as the production of lead is not keeping up with the many new applications of the metal.
>
> We have blocked out ore to date—5,472 tons in the Stemwinder mine, 71,823 tons in the Sullivan mine, and 4,082,611 tons in the Bunker Hill mine.

The ore milled (422,907 tons) was reduced to 75,229 tons of concentrate containing 48.48 per cent of lead and 16.52 ounces of silver to the ton. The ratio of concentration was 5.62 to 1, and the costs per ton mined were as follows: Mining, $3.433; concentrating, $0.865; shipping, $0.057; and other costs, $0.228; giving a total of $4.583. From 1886 to 1924 the company has mined 10,737,182 tons of ore, having a gross value of $120,858,095. Net smelter returns were $72,926,150 and operating profit $44,472,654. In September the

company celebrated the thirty-ninth birthday of the mine, and later gave assurance that the ore developed from the 1,700-foot level was as extensive as on any level above.

The Bunker Hill smelter and refinery has been operated continuously throughout the year on a two-furnace basis with a larger output than during any year since the plant began operations in 1917. This was made possible not only by the sustained output of the Hecla and Bunker Hill mines, but also because of increased receipts of miscellaneous custom ores. The project of doubling the capacity of the bag house and of constructing a new Cottrell treater with necessary spray chambers for the recovery of metal-bearing dust and fume was completed during the year and put into highly successful use, greatly improving the metallurgical efficiency of the plant, which is doubtless now equal to or better than that of any other smelter.

The company also conducted experiments on the treatment of silver-lead tailings by the Tainton process, in which the material is roughly concentrated, then roasted, and then leached with an acid brine. The metals are recovered electrolytically.

Siliceous silver-lead ore was shipped from old stopes in the Caledonia property. According to the statement to the county assessor, 5,919 tons of ore were extracted, which had a gross value of $162,335. The cost of extraction was $30,849, freight and treatment $59,061, and net profit $72,425. The company has a surplus of $479,944, but no distribution will be made until all Federal taxes for past years have been settled. The following paragraph is taken from the company's statement to stockholders for 1924:

Current production from various odds and ends in the mine continues at about the same rate as during 1923 and is profitably conducted largely because of the close and efficient work done by our employees, by the good metal prices now ruling, and by the exceptionally good facilities provided by the Bunker Hill smelter, which is practically at the portal of your mine. No new ore has been disclosed during the year, and the conclusion still remains that your mine is so thoroughly cut up by unsuccessful development work that the limits of the ore body are definitely known and that the disclosure of no new ore can be expected.

Considerable lead-zinc ore from the Constitution mine in the Pine Creek region was treated by concentration and flotation. The major product, lead-zinc concentrate, was shipped to Great Falls, Mont., and several lots of lead concentrate were treated at the Bunker Hill smelter. Operations at the mill were partly experimental and were conducted with a view to improving the milling process.

The Nabob Silver-Lead Co. in Pine Creek milled considerable ore and shipped several thousand tons of lead concentrate and lead-zinc concentrate before September, when the mill was destroyed by fire. As the company has a large quantity of ore in reserve, arrangements were made late in the year for shipping the ore to the Timber Butte custom mill, Butte, Mont. According to the company's annual report, the concentrate contained 31 ounces of gold, 25,791 ounces of silver, 1,164,470 pounds of lead, and 1,243,114 pounds of zinc, for which the smelters paid $64,267 after $114,091 was paid for freight and treatment. The operating loss was $23,424.

Development work on the property until very recently was confined almost entirely to the upper levels of the mine, where the ore bodies though narrow were of a very good grade. Work started on the 600 level shortly before the fire, and continued without interruption to this date, has shown such splendid results that we are now convinced that the future of the property is absolutely assured if an intelligent development program be carried out at depth.

We propose to continue the drift east on the 600-foot level for about 100 feet. This work will block out and make ready for mining a good body of ore which was stoped above the 400-foot level to surface. On November 8, we received a report from the mine superintendent that this drift was now showing 4 feet of ore of better grade than exposed elsewhere in the mine.

The Sierra Nevada mine was operated by lessees, who shipped several hundred tons of crude ore and concentrate to the Bunker Hill smelter. Work in the lower levels was discontinued by the company in November, 1923. A large quantity of old tailings was treated by the Hayes Co. in a 100-ton flotation plant, and considerable silver-lead concentrate was shipped from Pine Creek spur. Ore was also milled at the Big Creek property controlled by the Bunker Hill Co.; at the Crescent mine, which used the 75-ton flotation plant owned by the Alhambra Co.; and by the Amy Matchless Mining & Milling Co., which operated a 75-ton concentration-flotation plant from September to the end of December. A net profit, before depletion, of $24,168 was reported for the Crescent mine. Several lots of crude ore and concentrate were shipped from the Argo, General Metals Corporation, Stewart, and Highland Surprise mines. The last property has been a large producer of both lead and zinc and will probably again be active on company account early in 1925. At the Douglas mine, a producer of zinc ore in 1917 when it was leased to the Anaconda Copper Mining Co., tunnels were retimbered and buildings lost in forest fires were rebuilt. The company estimates 100,000 tons of silver-lead-zinc ore in reserve.

TWIN FALLS COUNTY

A little placer gold was taken from the banks of the Snake River near Buhl and Twin Falls. The Sandy Bar, Ether, and Gold Nugget properties operated on a small scale.

VALLEY COUNTY

Big Creek district.—Sluicing operations at the Pearl placer near Clover resulted in a small output of placer gold.

Deadwood Basin district.—Several hundred tons of free-milling gold ore were treated by amalgamation at the Merry Blue & Union property. Development work continued at the Lost Pilgrim property, which was being operated by the Bunker Hill & Sullivan Mining & Concentrating Co. A large ledge of lead ore of milling grade, opened at a depth of 100 feet, is being prospected at a depth of 600 feet by a crosscut tunnel.

Lake City district.—A little placer dust was saved by hydraulicking in Poorman Creek, near McCall.

WASHINGTON COUNTY

Heath district.—A 15-ton mill equipped for amalgamation and cyanidation was built at the Cuddy Mountain mine, where oxidized iron ore containing gold and silver is being opened by a tunnel to cut the vein at a depth of 200 feet.

Snake River district.—The Sturgill Creek placer, near Robinette, Oreg., yielded a little gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By C. N. Gerry

PRODUCTION

SUMMARY

The mine production of gold, silver, copper, lead, and zinc in Washington in 1924 was valued at 11 per cent less than in 1923, as several mines that usually are regular producers were shut down part or all of the year. Although the quantity of ore, gold, silver, and zinc decreased, the total value of the metal output was close to the yearly average of the decade 1915 to 1924, which was about $1,165,000.

A summary of the production by different kinds of ore from 1913 to 1922, given in Mineral Resources for 1922, shows that the gold came mainly from siliceous gold ore. Silver was divided about equally between siliceous ore and copper ore. The production of copper, though never large, reached 2,645,022 pounds in 1916. Considerable lead was produced from 1898 to 1924 and zinc from 1916 to 1924, largely from the Northport region. Since 1860 Washington metal mines have yielded gold, silver, copper, lead, and zinc valued at more than $43,000,000, of which 68 per cent represents the value of gold. No dividends have been paid from mining operations in the State since 1920, although one company was accumulating profits which will be distributed in 1925.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1924

	Number of producers	Ore	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	34	44,383	$309,617	213,742	928,458	3,935,376	910,890	$948,490
Increase or decrease from 1923	−2	−12,517	−32,450	−13,445	+56,459	+1,028,897	−2,113,645	−117,176
Total, 1860–1924			29,094,207	8,611,020	18,874,120	48,828,930	9,233,180	43,051,257

[a] Includes placer production.

ORE

The quantity of ore sold or treated in Washington decreased 22 per cent, as mining was quiet in Ferry, Whatcom, Okanogan, and Stevens Counties. The total average value of the ore increased from $18.70 in metals a ton in 1923 to $21.35 in 1924, and the value in gold and silver from $9.26 to $10.19 a ton. Of the total output 40 per cent was gold ore, most of which was mined in Ferry County.

The total and average recoverable content of crude ore and concentrates shipped is given on page 290.

Ore and metals produced in Washington in 1924

Source	Number of producers	Ore		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	12	17,543	39.53	14,705.87	98.18	69,887	32.70
Dry silver ore	1	32	.07	.28		291	.14
Copper ore	3	15,916	35.86	117.70	.79	44,173	20.67
Lead ore	13	8,111	18.28	120.10	.80	99,300	46.46
Zinc ore	1	2,781	6.26			79	.03
Total deep mines		44,383	100.00	14,943.95	99.77	213,730	100.00
Total placers	4			33.77	.23	12	
		44,383	100.00	14,977.72	100.00	213,742	100.00

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry silver ore	510	0.05				
Copper ore	927,407	99.89				
Lead ore	541	.06	3,916,260	99.51		
Zinc ore			19,116	.49	910,890	100.00
	928,458	100.00	3,935,376	100.00	910,890	100.00

The gold ore was largely siliceous smelting ore mined at Republic and ore treated by a new amalgamation mill in Whatcom County. The demands of the smelter at Trail, British Columbia, practically determine the production of the Republic mines, and the ore output was greatly decreased, though the average metal content was much higher than in 1923. The average content of all gold ores was $17.33 in gold and 3.98 ounces of silver to the ton.

Dry gold ore sold or treated in Washington in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Ferry	15,848	13,580.82	69,651
Okanogan	138	218.26	198
Whatcom	1,557	906.79	38
	17,543	14,705.87	69,887

Only one lot of silver ore was shipped and was from Stevens County. It averaged $0.18 in gold and 9.09 ounces of silver to the ton and yielded a little copper.

The copper ore, from Snohomish and Stevens Counties, was practically all milling ore and averaged $0.15 in gold and 2.78 ounces of silver to the ton and 2.91 per cent of copper.

Copper ore sold or treated in Washington in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Snohomish	14,300	100.70	8,646	803,348
Stevens	1,616	17.00	35,527	124,059
	15,916	117.70	44,173	927,407

Most of the lead ore was first-class ore from near Northport; it averaged $0.31 in gold and 12.24 ounces of silver to the ton and 24.14 per cent of lead.

Lead ore sold or treated in Washington in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ferry	32	0.50	696		5,250
Okanogan	8	6.48	279	77	1,959
Pend Oreille	966		1,291		868,920
Stevens	7,105	113.12	97,034	464	3,040,131
	8,111	120.10	99,300	541	3,916,260

The zinc ore produced in 1924 was of milling grade; it came from the Northport district and averaged 16.38 per cent of recoverable zinc before concentration. The following table gives the kind and grade of zinc material shipped from 1921 to 1924:

Zinc ore and concentrates (as marketed from Washington mines and mills) sold to smelters, 1921–1924

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrate	Recovered zinc
1921					
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Stevens	300	252,000	42.00	206,640
Zinc concentrates	do	348	296,000	42.53	242,720
		648	548,000	42.28	449,360
1922					
Oxidized zinc ore	do	1,554	1,444,976	46.49	1,228,229
1923					
Sulphide zinc ore	do	3,450	3,675,924	53.27	3,024,535
1924					
Zinc concentrates	do	933	1,071,635	57.43	910,890

GOLD

The decrease of 9 per cent in the output of gold was due chiefly to the idleness of the mill of the Boundary Red Mountain Mining Co., in Whatcom County. Ferry County yielded slightly more gold than in 1923, although much less ore was shipped. Gold and silver mills yielded 6 per cent of the gold, ores shipped directly to smelters yielded 93 per cent, and concentrates and placers only 1 per cent. More than 98 per cent of the gold came from gold ore, largely from Ferry and Whatcom Counties. The largest producers were the Knob Hill, Quilp, and Last Chance mines at Republic, and the Lone Jack mine in Whatcom County.

SILVER

The mine production of silver in Washington decreased 6 per cent in quantity. Most of the output came from Stevens County, where some rich silver-lead ore was mined. Ferry County, which was first in 1923, decreased in output and dropped to second place in 1924. Crude ore shipped to smelters supplied nearly 90 per cent of the silver and concentrates practically all the remainder. Lead ore contained 46 per cent of the silver, gold ore nearly 33 per cent, and copper ore nearly 21 per cent. The Old Dominion mine, near Colville, was the largest producer, and the United Silver-Copper mine at Chewelah was second. Other producers of more than 10,000 ounces each were the Knob Hill, Quilp, Last Chance, and Santa Rita mines.

COPPER

The mine production of copper in Washington increased 6 per cent in quantity, though it is still below the average for the decade 1915 to 1924. Output from the Chewelah district, Stevens County, was small, and Snohomish County, therefore, retained first place in the yield of copper. The Sunset Copper Co. near Index was the only large producer in the State.

LEAD

The mine production of lead in Washington increased 35 per cent in quantity in 1924 as a result of additional shipments from Metaline, Pend Oreille County, and Springdale and Northport, Stevens County. The Gladstone mine near Northport was the largest producer, as in 1923, and the Bella May, Santa Rita, and Old Dominion mines followed in order. The Electric Point mine, formerly the largest producer of lead in Washington, was idle in 1924, 1923, and most of 1922, but resumed shipments early in 1925.

ZINC

The mine production of zinc in Washington in 1924 decreased 70 per cent in quantity. The Black Rock mine near Northport shipped zinc concentrate to the electrolytic zinc plant at Black Eagle, near Great Falls, Mont., and to Grasselli, Ind.

MINING INDUSTRY

Although the value of Washington's metal output in 1924 was less than that of 1923, it exceeded the combined value of the output in 1921 and 1922. That mining was gradually improving is shown convincingly in the steady development of property at Republic, the interest in lead-silver mining [1] in several eastern districts, and the operation of a new mill in Whatcom County. The demand for lead ore has stimulated mining near Northport, where new deposits are being opened, and has encouraged prospecting at Metaline, Bossburg, and Colville, and in the region west of Springdale. Even the Electric Point Mining Co. yielded to the temptation to arrange its tax difficulties and prepare for regular shipments of lead ore in 1925. The output of siliceous ore from Republic was not record-breaking, but steady development of four of the old producers at depth has greatly improved the ore reserves of the district and presages a better output for the future. The smelting company at Trail, British Columbia, restricted shipments of siliceous ore somewhat, but some other means of treating the Republic ore may be devised. Mining of copper ore at Chewelah has declined in recent years, but the output of copper was upheld by the operation of the Sunset mine near Index.

METALLURGIC INDUSTRY

Eight milling plants in Washington were active in 1924. Of these, six were concentration mills (three used flotation with table concentration) and two used amalgamation.

Ore and concentrate from mines in Washington were smelted mainly at Tacoma, Wash.; Trail, British Columbia; Grasselli, Ind.; Bradley, Idaho; and East Helena, Mont. Since the removal of the lead plant at Northport, Wash., most smelting ore is shipped to plants outside the State, although the smelter and refinery at Tacoma continue to receive much copper ore and concentrate. The plant at Trail, British Columbia, which treats siliceous gold ore from Republic, is unusually complete, as it has units for milling, smelting, and refining ores containing gold, silver, copper, lead, and zinc. It was fully described [2] in 1923, but since that time the enlarging of the electrolytic zinc plant has started.

Nearly 4 per cent of the ore produced in Washington in 1924 (1,611 tons) was treated by amalgamation. The bullion contained gold valued at $19,460 and 43 ounces of silver, or an average of $12.10 in both metals per ton of ore. During the year 325 pounds of quicksilver, an average of 0.20 pound per ton of ore treated, were purchased for these mills but no cyanide was used.

Nearly 48 per cent of the ore was concentrated; it yielded 2,998 tons of concentrates, of which nearly half was copper concentrates. The increase of 756 tons over 1923 represented copper and zinc concentrates mainly.

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[1] Goodsell, C. H., Lead-silver mining improves in Washington State: Eng. and Min. Jour.-Press, vol. 118, Sept. 6, 1924, p. 386.

[2] Young, Geo. J., Eng. and Min. Jour.-Press, vol. 116, July 28, 1923, p. 139.

Mine production of metals from Washington concentrates in 1924

By counties

	Ore to concentrating mills	Concentrates	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ferry	5	1		26		352		$45
Snohomish	14,196	1,321	89.10	8,154	777,316			109,133
Stevens	7,083	1,676	15.48	13,829	29,905	396,339	910,890	104,419
	21,284	2,998	104.58	22,009	807,221	396,691	910,890	213,597

By kinds of concentrates

Copper	1,465	94.00	11,682	807,221			115,516
Lead	600	10.58	10,327		396,691		38,873
Zinc	933					910,890	59,208

Average recoverable content

		Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Copper	1,465	0.06	7.97	27.55			78.85
Lead	600	.02	17.21		33.06		64.79
Zinc	933					48.82	63.46
	2,998	.03	7.34	13.46	6.62	15.19	71.25

More than 48 per cent of the ore was shipped directly to smelters, and most of it came from Ferry and Stevens Counties. Of the shipping ore 74 per cent was dry and siliceous ore and 23 per cent lead ore. No first-class zinc ore and only a small quantity of copper ore was shipped.

Mine production of metals from Washington crude ore shipped to smelters in 1924

By counties

	Ore	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Ferry	15,875	13,581.32	70,321		4,898	$328,258
Okanogan	92	190.15	472	77	1,959	4,413
Pend Oreille	966		1,291		868,920	70,378
Snohomish	104	11.60	492	26,032		3,980
Stevens	4,451	114.94	119,102	95,128	2,662,908	307,669
	21,488	13,898.01	191,678	121,237	3,538,685	714,698

By kinds of ore

Dry and siliceous	15,964	13,764.79	70,135	510		331,600
Copper	568	23.70	32,491	120,186		38,003
Lead	4,956	109.52	89,052	541	3,538,685	345,095

Average recoverable content

		Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	
Dry and siliceous	15,964	0.86	4.39			20.77
Copper: Sulphide	568	.04	57.20	10.58		66.91
Lead:						
Oxidized	2,220				26.20	41.92
Sulphide	2,736	.04	32.55		43.41	92.12
	21,488	.65	8.92	.28	8.23	33.26

REVIEW BY COUNTIES

GENERAL FEATURES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1924

County	Ore (short tons)	Gold •		Silver •	
		Fine ounces	Value	Fine ounces	Value
Ferry	15,880	13,581.32	$280,751	70,347	$47,132
Kittitas		30.24	625	11	7
Okanogan	146	224.75	4,646	477	320
Pend Oreille	966			1,291	865
Snohomish	14,300	100.67	2,081	8,646	5,793
Stevens	11,534	130.42	2,696	132,931	89,064
Walla Walla		3.53	73	1	.1
Whatcom	1,557	906.79	18,745	38	25
	44,383	14,977.72	309,617	213,742	143,207
Total, 1923	56,900	16,547.49	342,067	227,187	186,293

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ferry			5,250	$420			$328,303
Kittitas							632
Okanogan	77	$10	1,959	157			5,133
Pend Oreille			868,920	69,513			70,378
Snohomish	803,348	105,239					113,113
Stevens	125,033	16,379	3,059,247	244,740	910,890	$59,208	412,087
Walla Walla							74
Whatcom							18,770
	928,458	121,628	3,935,376	314,830	910,890	59,208	948,490
Total, 1923	871,999	128,184	2,906,479	203,454	3,024,535	205,668	1,065,666

• Includes placer production.

Ore sold or treated, deep mines producing, and average value of ore in Washington, 1923–24, by counties

County	Ore sold or treated, 1924 (short tons)		Number of deep mines producing		Average total value per ton •		Average value per ton in gold and silver •	
	Total	Increase or decrease	1923	1924	1923	1924	1923	1924
Ferry	15,880	−8,666	7	7	$14.60	$20.67	$14.54	$20.65
Okanogan	146	−3,271	7	8	8.19	35.16	7.87	34.01
Pend Oreille	966	+82	3	2	6.46	72.86	.51	.90
Snohomish	14,300	+5,302	1	2	11.63	7.91	1.04	.55
Stevens	11,534	−1,893	10	10	37.79	35.73	5.45	7.96
Whatcom	1,557	−4,071	2	1	10.66	12.06	10.66	12.06
	44,383	−12,517	30	30	18.70	21.35	9.26	10.19

• Placer product excluded.

CHELAN COUNTY

Although no ore was shipped from Chelan County in 1924, the Royal Development Co., in the Leavenworth district, drove a 1,650-foot tunnel and opened up a large deposit of low-grade copper ore containing silver. The Magnetite mine near Blewett has developed much oxidized iron ore said to contain some nickel and chromium.

FERRY COUNTY

Danville district.—One test lot of lead ore was shipped from the Minnehaha claim.

Enterprise district.—Considerable ore is blocked out at the Longstreet and Cuba properties near Covada, but most of it is not rich enough to pay for the long haul to the railroad.

Keller district.—Work at the Iron Creek mine comprised 450 feet of drifting and a trial mill run on sulphide ore. Reserves consist of several thousand tons of silver-lead-iron ore in a fissure vein in limestone. The cyanide plant formerly erected does not treat the ore recently mined to good advantage, as the chief minerals are galena and pyrite, and simple concentration is not entirely satisfactory because of the iron content. Concentrate was hauled 35 miles by wagon to the nearest railroad station. At the Addison mine milling ore containing silver, copper, and lead has been blocked out.

Republic district.—Six deep mines in the Republic district produced 15,848 tons of ore, yielding $280,741 in gold and 69,651 ounces of silver, valued together at $327,407, or $20.66 a ton. The quantity of ore, which is shipped to smelters and used as a silica flux, was decidedly less than in 1923, but its grade was much better. From 1896 to the end of 1924 the district produced 611,586 tons of ore, yielding $7,775,439 in gold and 2,293,521 ounces of silver, valued together at $9,225,110. The largest producers of the district were the Quilp Gold Mining Co., Last Chance mine of the Lone Pine-Surprise Consolidated Mining Co., and the Knob Hill mine owned by the Balaklala Consolidated Copper Co.

The largest quantity of ore was from the Quilp mine, where 380 feet of development—shaft sinking and raising—was done. The richest ore and the largest output of gold and silver came from the Knob Hill property, which has several thousand tons of $20 gold ore in reserve. The mine is opened by a 250-foot vertical shaft and a 560-foot inclined shaft. In 1924 the company did 950 feet of development work in drifting, raising, and shaft sinking. Rich gold ore was found in the deepest workings, but the ore shoots are said to be irregular.

The Last Chance mine was active only five months in 1924, as the demand for siliceous ore at the Trail smelter did not warrant continuous operations. The mine is opened by a vertical shaft 690 feet deep, and from the 650-foot level a winze is sunk 150 feet in the vein.

Lessees at the Republic mine shipped several cars of rich gold ore. The Surprise-Lone Pine-Pearl property of the Northport Smelting & Refining Co. continued to develop the ore body at depth and to block out ore. In October the company was sinking the Surprise shaft from the 900-foot level, and a station at the 1,150-foot level was proposed. Work at the Golden Eagle mine, which has a 500-foot shaft, was resumed in September. The activity at the Surprise, Quilp, and Knob Hill mines indicates that the ore deposits of the Republic district are being thoroughly prospected at considerable depth. No figures are published regarding reserves, but it has been suggested that some metallurgical process other than smelting might be devised if enough ore is blocked out.

According to a recent article,[3] the district needs capital to supply electric power from Kettle Falls for any large milling process.

KING COUNTY

The Snoqualmie Mining Co. near Miller River has a small flotation plant and plans to build a cyanide mill to treat concentrates containing gold.

KITTITAS COUNTY

Three placers in the Swauk district produced $625 in gold and 11 ounces of silver, valued together at $632. The largest producer was the Golden Rule placer at Liberty, operated by lessees.

OKANOGAN COUNTY

Conconully district.—One small lot of rich gold ore from the Last Chance mine was treated by amalgamation. Ore containing silver, copper, and lead was opened at the Peacock Silver mine but was not shipped.

Meyers Creek district.—Four deep mines in the Meyers Creek district produced 60 tons of ore that yielded $1,923 in gold and 174 ounces of silver, valued together at $2,040, or $34 a ton. Other than a small lot for an amalgamation test, the product was first-class ore shipped to the smelter; it consisted of gold ore from the Gray Eagle and Eagle & Rattler properties, near Chesaw. Very rich gold ore was found at the Reco mine, but not enough to warrant the expense of building a mill.

Palmer Mountain district.—Several small lots of sulphide lead ore were shipped from the King Solomon and other properties near Oroville and Molson.

Squaw Creek district.—One lot of rich gold ore was shipped from the Hidden Treasure and Highland Light property near Methow, and a little ore was treated by amalgamation. The gold ore occurs in a fissure vein in granite, and the property is opened by a shaft and several tunnels, including one 800 feet long. A small ball mill and a Wilfley concentrator were erected in 1924.

PEND OREILLE COUNTY

Metaline district.—The Metaline district shipped 966 tons of ore, yielding 1,291 ounces of silver and 868,920 pounds of lead, valued together at $70,378, or $72.86 a ton. The chief operators were the Bella May, Grandview, and Cliff mines near Metaline. About 250 feet of development work was done at the Bella May mine, where sulphide lead ore occurs in pockets. Considerable ore was shipped to the Bunker Hill smelter by the lessee and by the owners, Wm. Kroll and A. H. Kroll; late in the year the property was bonded to the Belle May Co., of Yakima, Wash. Several shipments of lead ore were also marketed from the Grandview property, and some ore from the Cliff mine was hauled to the railroad but not shipped in 1924.

PIERCE COUNTY

Copper ore and concentrate from Index and Chewelah and custom ore from various districts in the State were shipped to the copper smelter and refinery at Tacoma. That plant was active in 1924,

[3] Freeman, O. W., Republic, Wash., needs capital: Eng. and Min. Jour.-Press, vol. 119, Feb. 28, 1925, p. 378.

smelting chiefly ores received by boat from Alaska, British Columbia, and South America. A description[4] of the plant, which has three blast furnaces, a large reverberatory furnace, four converters, Cottrell plant, arsenic plant, and refinery, appeared in April.

SNOHOMISH COUNTY

Index district.—The Sunset Copper Co., the largest copper producer in Washington in 1924, was active from April to the end of the year, and a large quantity of copper concentrate was shipped to Tacoma from the 150-ton concentration mill. The property is said to have 100,000 tons of milling ore in reserve. Development work consisted of 700 feet of drifts.

Stilaguamish district.—One lot of copper ore was shipped from the Wayside mine, two miles east of Granite Falls. The property is operated by the American Copper Co., which owns 160 acres of patented land.

STEVENS COUNTY

Bossburg district.—Several lots of crude ore and concentrate were shipped from the Bonanza and Young American mines near Bossburg. Steady development proceeded at the Bonanza property, where considerable milling ore has been opened. Several tunnels on the Silver Trail property have exposed a large quantity of silver-lead ore of milling grade.

Chewelah district.—The United Silver-Copper mine northeast of Chewelah, formerly a large producer of both silver and copper, was active throughout the year. Several hundred tons of crude ore and concentrate were shipped to Tacoma. A 100-ton mill treated low-grade ore a short time.

Colville district.—Shipments of sulphide lead ore carrying considerable silver were made from the Old Dominion mine, which is opened by an incline shaft and a 2,600-foot tunnel. During the year the company installed electric power and two compressors and was developing at depth the rich ore body mined in 1885 near the surface. The company has in reserve several thousand tons of silver-lead ore, some of it high grade. Specimens from the property show galena and cerussite with visible native silver. The ore also contains sphalerite and tests for the possible separation of this were made. At the Chloride Queen mine, 14 miles north of Colville, considerable silver-lead ore of milling grade was said to have been opened by an 850-foot tunnel, and a 50-ton concentration mill for its treatment was being erected.

Northport district.—First-class ore from the Gladstone property, the largest producer of lead in Washington, and zinc concentrates from the Washington Black Rock mine, the largest producer of zinc in the State, comprised the yield of the Northport district. The Electric Point mine, formerly a large producer of lead, made no shipments in 1924, but preparations were under way at the end of the year to resume shipments early in 1925. A recent article[5] describes the deposit and gives the history of the mine.

At the Gladstone property development was encouraging; several new chimneys of ore were opened by systematic trenching. Several

[4] Young, G. J., The Tacoma copper smelter and refinery: Eng. and Min. Jour-Press., vol. 119, Apr. 4, 1925, p. 557.

[5] Howard, L. O., Northport interesting to geologists: Min. Truth, May 16, 1925, p. 7.

thousand tons of lead ore were shipped to the Bunker Hill smelter at Bradley, Idaho; about one-third was first-class sulphide ore and the remainder lower-grade carbonate material. The long haul to the railroad and the low silver content of the ore are not preventing profitable operation, and the company has decided to declare regular dividends early in 1925. The enterprise is described in an article[6] in Mining Truth.

The output of the Black Rock mine was much smaller than in 1923; a good zinc concentrate from a small mill equipped with crusher, rolls, jigs, and tables was shipped to the Grasselli Chemical Co., at Grasselli, Ind., and the Anaconda Copper Mining Co., at Black Eagle, near Great Falls, Mont. The mine is opened by a shaft 600 feet deep; this shaft was deepened in 1924 and some prospecting done by diamond drill.

Springdale district.—Several thousand tons of lead ore were treated by concentration and flotation at the Santa Rita property, 18 miles west of Springdale, on the Great Northern Railroad. Concentrate from the 50-ton mill was shipped to the Bunker Hill smelter at Bradley, Idaho. The Deer Trail mine, an old producer of silver, was consolidated with the Elephant and Providence properties and operated by the Venus Silver Mines Co. A large reserve of silver ore containing some lead was said to have been blocked out, and a mill, part of which is on the ground, is planned to treat it.

Summit district.—The Consolidated Silver Mountain Mines Co., operating near Daisy, shipped one lot of lead ore rich in silver. The company reports reserves of 250,000 tons of ore containing silver, lead, zinc, and some arsenic. The property now has a 75-ton mill, and good results are reported from concentration tests with rolls and tables, following changes in the flow sheet during 1924.

Valley district.—Sulphide copper ore is being developed at the Admiral property near Valley, which is opened by 900 feet of drifting and raising.

WHATCOM COUNTY

Mount Baker district.—The Mount Baker district produced much less gold in 1924, because the mill at the Boundary Red Mountain Mining Co., south of Sardis, British Columbia, was idle. The crosscut tunnel was, however, driven 2,040 feet to open the vein at depth. A quantity of gold ore was treated by amalgamation at the Lone Jack mine, worked by the Brooks-Willis Metals (Inc.), which is opened by 2,200 feet of drifts and tunnels and is equipped with a 50-ton mill where the ore is treated by amalgamation after coarse and fine grinding. Gold bullion was shipped to the Dominion assay office, at Vancouver, British Columbia. It is planned to drive a 900-foot tunnel in the spring of 1925 to supplant the aerial tramway and to prospect the vein 500 feet below the present tunnel level.

Slate Creek district.—At the property of the Slate Creek Gold Mining Co., which is equipped with a 10-stamp mill and a Lane roller mill, much low-grade ore is blocked out, but a dispute over electric power has prevented mining for several years.

[6] Starmont, Leon, Min. Truth, May 2, 1925, p. 5.

IRON ORE, PIG IRON, AND STEEL

By Ernest F. Burchard and Hubert W. Davis [1]

GENERAL REVIEW

In 1924 the production and the shipments of iron ore decreased 22 and 25 per cent, respectively, as compared with 1923. The production ranked about with that of 1915, and was 99 per cent of the average for the preceding 5 years and 92 per cent of the average for the preceding 10 years. The output of pig iron decreased 22 per cent as compared with 1923 and was about 103 per cent of the average for the preceding 5 years and about 97 per cent of the average for the preceding 10 years. This output was about equal to that of 1919, the first postwar year.

The average value per ton for iron ore at the mines decreased about 16 per cent and that of pig iron at the blast furnaces 13 per cent. The quoted prices of ferromanganese, spiegeleisen, and steel showed considerable decreases. In operations, production, and earnings the year 1924 was very disappointing in the iron and steel industry.

The steel industry had scarcely adjusted itself to the change from a 12-hour to an 8-hour day, which was brought about through Government influence in 1923, when in July, 1924, the Federal Trade Commission ordered the discontinuance of the system of basing steel prices on the price at the Pittsburgh mills plus the freight to destination. As this order did not become operative until September, its full effects had not become established at the close of the year. One immediate effect is said to have been the reduction of prices on several products to western buyers, and some other effects were the establishment of several new basing points, the shifting of buying to more advantageous centers, plans for an increase of steel-making capacity in the Chicago district, and larger movement of steel products from the Pittsburgh district by barge to Memphis, New Orleans, and other river points.

Labor conditions appear to have been fairly satisfactory at both mines and mills, as was to be expected in a year of light demand. Transportation conditions were also generally satisfactory, car supply being ample and the Lake fleet capable of carrying a much larger quantity of ore.

The railroads were the leading buyers of steel in 1924; they were followed by building and general construction, automobile manufacturing, the oil, gas, and mining industries, exports, agriculture, and machinery. All but the first two outlets for steel showed decreases.

The total domestic output of pig iron required probably about 59 per cent of the apparent maximum capacity of the country, according to figures of the American Iron and Steel Institute; but this capacity

[1] Figures of imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

was not utilized steadily, for at the beginning of 1924 there were only 239 furnaces in blast; on June 30 there were 164, and at the end of the year there were 235. The production of steel ingots is considered to have been about 63 per cent of capacity, the output having ranged from about 38 per cent of the capacity in July to 86 per cent in March. The output of pig iron in the United States represents about half of the world's production and is more than that of all the producing countries of Europe combined.

Iron ore mining in the Lake Superior district had a lean year in 1924 because of smaller demand and a cut of 80 cents a ton in ore prices. Eastern furnaces took virtually no Lake ore because they could obtain foreign ore more cheaply. Shipments did not reach consumption by about 2,000,000 tons, which may prove a favorable factor for a good movement down the Lakes in 1925. Both large producers who consume their own ore and independent producers undoubtedly sustained losses because in a year of small production overhead charges are larger in proportion, and in 1924 there were no reductions in such mining charges as labor, supplies, and taxes. Since the war the capacity of the mines has considerably exceeded the normal consumption of ore, and this tends to maintain high charges for overhead and interest. Immense sums are being paid in taxes by the iron-mining companies in Minnesota, the total for 1924 being considered approximately $28,000,000; this sum, if borne by 31,076,000 tons of ore valued at $93,311,000, indicates nearly 30 per cent of the value of the ore at the mine. The season of 1924 ended with stock piles larger than at the close of 1923, especially on the Marquette and other Michigan ranges. The total increase in stocks in the Lake Superior district amounted to 21 per cent.

IRON ORE

QUANTITIES MINED AND SHIPPED IN 1924

In the accompanying table the quantities of iron ore shown include beneficiated ore, if the ore was treated in any way. The figures for both production and shipments include the iron ore used for fluxing other metallic ores at smelters in the Western States; but the shipments do not include the iron ore sold for the manufacture of paint, which amounted to 20,630 gross tons in 1924, valued at $103,626, or $5.02 a ton, compared with 24,842 tons in 1923, valued at $140,306, or $5.65 a ton. The output of manganiferous iron ore (including ore used for flux), which contained 5 per cent or more of manganese, amounted to 898,468 gross tons, valued at $2,739,254, as compared with 1,433,897 tons, valued at $4,888,393, in 1923. In Arkansas one producer shipped a small quantity of loadstone, which is not included in the tabulated statistics of iron ore.

In both 1923 and 1924 iron ore was mined in 20 States. Ohio, which has been absent from the list of producing States since 1916, and Washington contributed to the output in 1924; but Idaho and Nevada, each of which produced small quantities of ore in 1923, did not report a production in 1924. All the iron ore produced in California and Montana and a small quantity of that produced in Utah and Wyoming was used for flux; a small quantity of ore from New Jersey and Pennsylvania was used for purifying gas; all of the output

from Washington was used in the manufacture of ferromagnesite; a small quantity from New Jersey was used for filtration purposes. The ore produced in the remaining States was mainly for use in blast furnaces. Georgia, Michigan, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin produced small quantities that were used for paint. The rank of the three States producing the largest quantity of iron ore—Minnesota, Michigan, and Alabama—remained practically unchanged. Minnesota, which has furnished nearly 61 per cent of the total for the United States in the last five years, is producing more iron ore than all the rest of the States together.

The ores of iron are classed under four heads—hematite, brown ore, magnetite, and carbonate.[2]

Iron ore mined in the United States, 1923-24, by States and varieties, in gross tons, with percentage of increase or decrease in 1924

[Exclusive of ore containing 5 per cent or more of manganese]

State	Hematite	Brown ore	Magnetite	Carbonate	Total	Percentage of increase or decrease in 1924
1923						
Alabama	5,983,568	799,578			6,783,146	
California			2,779		2,779	
Colorado		4,102			4,102	
Georgia	21,193	96,128			117,321	
Idaho	1,290				1,290	
Michigan	14,174,468				14,174,468	
Minnesota	44,262,908		85,388		44,348,296	
Missouri	40,630	12,916			53,546	
Montana	(a)	[a] 17,751			17,751	
Nevada		9,578			9,578	
New Jersey			307,733		307,733	
New Mexico			205,218		205,218	
New York	12,849		529,073		541,922	
North Carolina		13,899	45,785		59,684	
Pennsylvania		1,284	988,641	3,516	993,441	
Tennessee	165,630	101,645			267,275	
Utah	[a] 2,700	[a] 32,331	22,721		57,752	
Virginia	12,341	143,636			155,977	
Wisconsin	868,130		3,286		871,416	
Wyoming	378,747				378,747	
	[a]65,924,454	[a] 1,232,848	2,190,624	3,516	69,351,442	
1924						
Alabama	6,398,119	595,494			6,993,613	+3
California			435		435	−84
Colorado		4,702			4,702	+15
Georgia	38,217	74,822			113,039	−4
Michigan	12,350,755				12,350,755	−13
Minnesota	31,857,132		44,953		31,902,085	−28
Missouri	72,425	7,422			79,847	+49
Montana	(a)	[a] 3,913			3,913	−78
New Jersey			65,197		65,197	−79
New Mexico			189,371		189,371	−8
New York	12,966		242,866		255,832	−53
North Carolina		12,525			12,525	−79
Ohio				244	244	
Pennsylvania		1,014	803,189	3,005	807,208	−19
Tennessee	171,254	8,599			179,853	−33
Utah	[a] 148,278	[a] 15,876			164,154	+184
Virginia		89,792			89,792	−42
Washington			1,700		1,700	
Wisconsin	690,058				690,058	−21
Wyoming	363,096				363,096	−4
	[a]52,102,300	[a] 814,159	1,347,711	3,249	54,267,419	−22

[a] Some hematite included with brown ore.

[2] Notes concerning the composition of these ores are given in U. S. Geol. Survey Mineral Resources, 1916, pt. 1, pp. 537-541, 1918.

The ore reported as sold for fluxing other than in the manufacture of pig iron amounted to 31,212 gross tons, valued at $96,209, as compared with 86,869 tons, valued at $300,318, in 1923. The ore reported as sold for purifying gas amounted to 1,970 gross tons, valued at $14,640. The domestic iron ore sold for the manufacture of pig iron amounted to 52,048,419 gross tons, valued at $151,191,475, compared with 69,723,362 tons, valued at $240,427,318, in 1923.

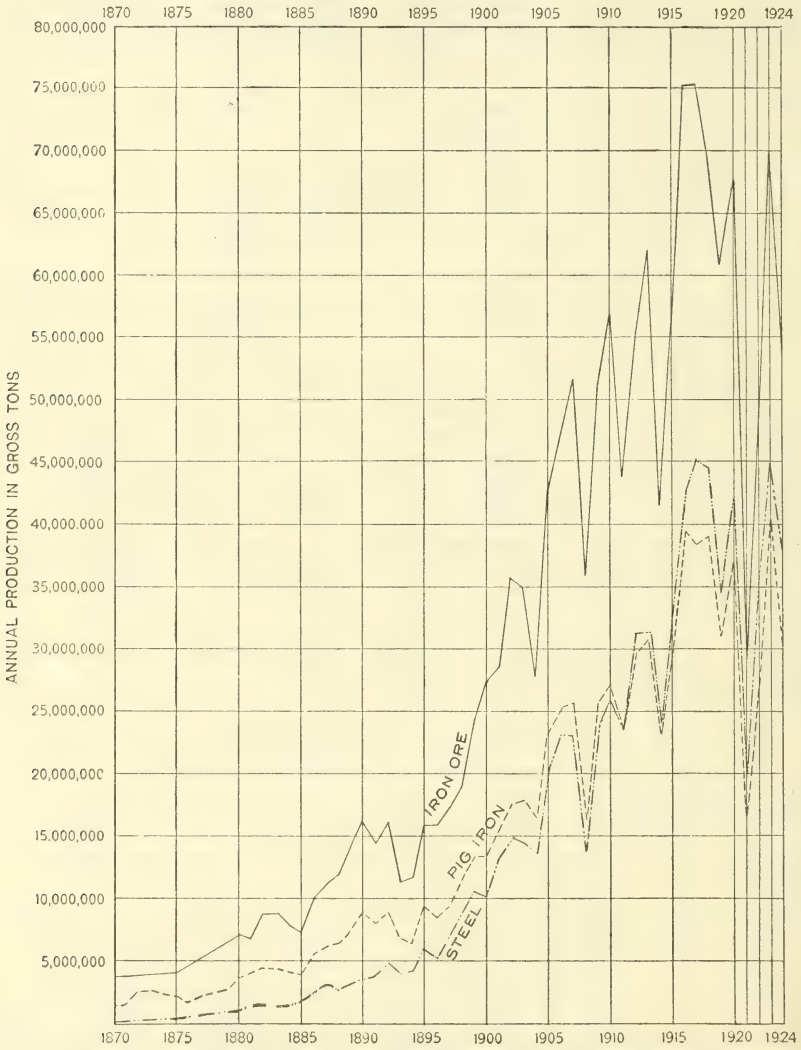

FIGURE 8.—Annual production of iron ore, pig iron, and steel in the United States, 1870–1924

Figure 8 compares the annual production of iron ore and its derived metals, pig iron and steel, since 1870. The figures for the three products are not strictly comparable, however, because considerable foreign iron ore and also some cinder, scale, and scrap enter into the production of domestic pig iron; and considerable scrap iron and steel, as well as cinder and scale, enter into the production of new steel.

In the following table the shipments by States have been subdivided according to the several uses reported.

Iron ore shipped from mines in the United States, 1923–24, by States and uses, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

State	Pig iron	Flux	Paint	Other	Total
1923					
Alabama	6, 922, 663				6, 922, 663
California		2, 769	10		2, 779
Colorado	4, 102				4, 102
Georgia	117, 286				117, 286
Idaho		1, 290			1, 290
Michigan	14, 065, 561		4, 377		14, 069, 938
Minnesota	44, 556, 053				44, 556, 053
Missouri	54, 348				54, 348
Montana		17, 751			17, 751
Nevada		9, 578			9, 578
New Jersey	349, 148			287	349, 435
New Mexico	205, 218				205, 218
New York	722, 096		12, 849		734, 945
North Carolina	59, 684				59, 684
Pennsylvania	987, 632		3, 516	954	992, 102
Tennessee	266, 175		1, 100		267, 275
Utah	2, 271	55, 481			57, 752
Virginia	200, 966				200, 966
Wisconsin	831, 412		2, 990		834, 402
Wyoming	378, 747				378, 747
	69, 723, 362	86, 869	24, 842	1, 241	69, 836, 314
1924					
Alabama	6, 557, 596				6, 557, 596
California		435			435
Colorado	4, 702				4, 702
Georgia	112, 059		482		112, 541
Michigan	11, 248, 641		2, 296		11, 250, 937
Minnesota	31, 076, 114				31, 076, 114
Missouri	79, 847				79, 847
Montana		3, 913			3, 913
New Jersey	100, 093		208	1, 030	101, 331
New Mexico	189, 371				189, 371
New York	303, 386		12, 966		316, 352
North Carolina	12, 525				12, 525
Ohio	244				244
Pennsylvania	806, 397		3, 005	1, 014	810, 416
Tennessee	179, 293		560		179, 853
Utah	144, 525	19, 629			164, 154
Virginia	91, 759				91, 759
Washington				1, 700	1, 700
Wisconsin	786, 006		1, 113		787, 119
Wyoming	355, 861	7, 235			363, 096
	52, 048, 419	31, 212	20, 630	3, 744	52, 104, 005

Iron ore shipped from mines in the United States, 1923–24, by States

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	1923		1924		Percentage of increase or decrease	
	Gross tons	Value	Gross tons	Value	Quantity	Value
Alabama	6,922,663	$15,540,198	6,557,596	$13,927,551	−5	−10
California	2,769	18,665	435	[a]	−84	
Colorado	4,102	[a]	4,702	[a]	+15	
Georgia	117,286	300,712	112,059	285,128	−4	−5
Idaho	1,290	[a]			−100	−100
Michigan	14,065,561	54,110,070	11,248,641	35,605,902	−20	−34
Minnesota	44,556,053	158,402,788	31,076,114	93,311,092	−30	−41
Missouri	54,348	247,975	79,847	405,622	+47	+64
Montana	17,751	51,039	3,913	10,846	−78	−79
Nevada	9,578	[a]			−100	−100
New Jersey	349,435	1,403,723	101,123	420,488	−71	−70
New Mexico	205,218	[a]	189,371	[a]	−8	
New York	722,096	3,242,229	303,386	1,448,616	−58	−55
North Carolina	59,684	161,603	12,525	32,512	−79	−80
Ohio			244	[a]		
Pennsylvania	988,586	2,264,485	807,411	1,881,122	−18	−17
Tennessee	266,175	677,753	179,293	431,682	−33	−36
Utah	57,752	205,936	164,154	234,348	+184	+14
Virginia	200,966	664,240	91,759	250,279	−54	−62
Washington			1,700	[a]		
Wisconsin	831,412	2,421,194	786,006	2,044,762	−5	−16
Wyoming	378,747	[a]	363,096	[a]	−4	
Undistributed		[b] 1,026,311		[b] 1,017,155		
	69,811,472	240,738,921	52,083,375	151,307,105	−25	−37

[a] Included under "Undistributed." [b] This figure includes value for States entered as "[a]" above.

Iron ore mined in the United States, by mining districts and varieties, 1923–24, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total	Percentage of increase or decrease in 1924
1923						
Lake Superior [a]	59,196,734		88,674		59,285,408	
Birmingham	5,740,233	306,675			6,046,908	
Chattanooga	494,948	229,102			634,050	
Adirondack			460,311		460,311	
Northern New Jersey and southeastern New York			376,495		376,495	
Other districts	[b] 582,539	[b] 697,071	1,265,144	3,516	2,548,270	
	[b]65,924,454	[b] 1,232,848	2,190,624	3,516	69,351,442	
1924						
Lake Superior [a]	44,796,766		44,953		44,841,719	−24
Birmingham	6,214,381	296,931			6,511,312	+8
Chattanooga	376,693	171,004			547,697	−14
Adirondack			197,437		197,437	−57
Northern New Jersey and southeastern New York			110,626		110,626	−71
Other districts	[b] 714,460	[b] 346,224	994,695	3,249	2,058,628	−19
	[b]52,102,300	[b] 814,159	1,347,711	3,249	54,267,419	−22

[a] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[b] Some hematite included with brown ore.

The Lake Superior district, comprising Minnesota, Michigan, and northern Wisconsin, mined nearly 83 per cent of the total ore in 1924; and the Birmingham district, in Alabama, mined 12 per cent. The Birmingham district was the only one to produce more ore in 1924 than in 1923, the output increasing 8 per cent.

The following table shows the production of iron ore in the United States so far as it has been recorded or estimated. The figures for the years prior to 1860 are not strictly accurate, as they were calculated from the pig iron produced and included both imported and domestic ore. Details for the years 1880 to 1916 may be found in Mineral Resources for 1916:

Iron ore mined in the United States, 1810–1924, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1810–1869					49, 656, 000
1870[a]–1880					51, 690, 889
1881–1890					103, 854, 386
1891–1900	136, 961, 046	22, 845, 764	14, 634, 364	1, 065, 137	175, 506, 311
1901–1910	364, 179, 432	[b] 28, 287, 994	[b] 20, 664, 453	262, 366	413, 394, 245
1911–1915	239, 419, 251	8, 355, 102	10, 156, 539	42, 495	257, 973, 387
1916	70, 728, 024	1, 904, 484	2, 533, 364	1, 800	75, 167, 672
1917	70, 743, 513	1, 992, 332	2, 553, 006		75, 288, 851
1918	65, 894, 709	1, 613, 844	2, 149, 725		69, 658, 278
1919	[c] 57, 719, 582	1, 127, 397	[c] 2, 118, 439		60, 965, 418
1920	[c d] 63, 883, 523	[d] 1, 325, 661	[c] 2, 391, 541	3, 740	67, 604, 465
1921	[c d] 28, 337, 249	[d] 370, 154	[c] 780, 866	2, 709	29, 490, 978
1922	[d] 44, 888, 723	[d] 783, 582	1, 452, 966	3, 256	47, 128, 527
1923	[d] 65, 924, 454	[d] 1, 232, 848	2, 190, 624	3, 516	69, 351, 442
1924	[d] 52, 102. 300	[d] 814, 159	1, 347, 711	3, 249	54, 267, 419
					1, 600, 998, 268

[a] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[b] Some brown ore included with magnetite.
[c] Some magnetite included with hematite.
[d] Some hematite included with brown ore.

PRINCIPAL IRON-ORE MINES

In 1924 there were 260 iron-ore mines active, compared with 309 in 1923 and 293 in 1922; 117 mines produced more than 100,000 gross tons of iron ore each, compared with 139 in 1923 and 109 in 1922. Of these 117 mines 9 (7 in Minnesota, 1 in Alabama, and 1 in Michigan) produced more than 1,000,000 tons each, as against 9 (7 in Minnesota, 1 in Alabama, and 1 in Michigan) in 1923 and 7 (5 in Minnesota, 1 in Alabama, and 1 in Michigan) in 1922. The operators of these large mines have permitted the publication of output, and the figures are given in the table that follows. The predominance of hematite as an ore of iron is clearly shown by the fact that, of these 117 large mines, only 3 produced magnetite and 1 produced brown ore. The trend toward large mining units is shown in the production of 93 per cent of the output of the country by the 117 mines that yielded more than 100,000 tons each.

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1924

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
1	Hull-Rust	Minnesota	Hibbing	Hematite	4, 653, 594
2	Red Mountain group	Alabama	Bessemer	do	3, 609, 690
3	Missabe Mountain	Minnesota	Virginia	do	3, 182, 801
4	Mahoning	do	Hibbing	do	1, 717, 092
5	Spruce	do	Eveleth	do	1, 555, 823

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1924—Continued

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
6	Norrie group	Michigan	Ironwood	Hematite	1,471,394
7	Morris	Minnesota	Hibbing	do	1,320,655
8	Hill Annex	do	Calumet	do	1,190,237
9	Canisteo	do	Coleraine	do	1,150,117
10	Little and Prindle	do	Keewatin	do	956,369
11	Woodward Nos. 1, 2, and 3	Alabama	Bessemer	do	846,083
12	Holman	Minnesota	Taconite	do	754,726
13	Cornwall	Pennsylvania	Miners Village	Magnetite	694,700
14	Newport (including Bonnie)	Michigan	Ironwood	Hematite	687,885
15	Dunwoody	Minnesota	Chisholm	do	684,341
16	Adams	do	Eveleth	do	607,633
17	Glen	do	Chisholm	do	588,260
18	Bennett	do	Keewatin	do	585,716
19	Pioneer	do	Ely	do	578,736
20	Boeing	do	Hibbing	do	524,781
21	Sloss Nos. 1 and 2	Alabama	Bessemer	do	509,638
22	Leonard	Minnesota	Chisholm	do	509,589
23	Plymouth	Michigan	Verona	do	504,191
24	St. James	Minnesota	Aurora	do	503,006
25	Montreal	Wisconsin	Montreal	do	499,812
26	Raimund Nos. 1 and 2	Alabama	Bessemer	do	498,114
27	Susquehanna	Minnesota	Hibbing	do	494,603
28	Fayal	do	Eveleth	do	490,912
29	Chapin (including Millie)	Michigan	Iron Mountain	do	445,101
30	Hawkins	Minnesota	Nashwauk	do	417,608
31	Ironton	Michigan	Bessemer	do	400,000
32	Armour No. 2 (including Cuyuna-Duluth).	Minnesota	Crosby	do	389,446
33	Dean	do	Buhl	do	378,042
34	Sunrise	Wyoming	Sunrise	do	363,096
35	Leonidas	Minnesota	Eveleth	do	361,886
36	Songo	Alabama	Bessemer	do	356,580
37	Wellington	Minnesota	Chisholm	do	353,192
38	Zenith	do	Ely	do	348,252
39	Corsica	do	McKinley	do	326,405
40	Negaunee	Michigan	Negaunee	do	323,123
41	Lake Superior	do	Ishpeming	do	313,679
42	Hill-Trumbull	Minnesota	Marble	do	302,995
43	Scranton	do	Hibbing	do	302,383
44	Cliffs Shaft	Michigan	Ishpeming	do	296,508
45	South Judd	Minnesota	Taconite	do	292,561
46	Laura	do	Hibbing	do	286,934
47	Eureka	Michigan	Ramsay	do	271,701
48	Palms	do	Bessemer	do	271,207
49	Sargent	Minnesota	Keewatin	do	269,164
50	Alexandria	do	Chisholm	do	267,721
51	Aragon	Michigan	Norway	do	266,883
52	Riverton group	do	Iron River	do	256,249
53	Richmond	do	Palmer	do	255,429
54	Berkshire	do	Stambaugh	do	254,591
55	Chisholm	Minnesota	Chisholm	do	252,326
56	Stephenson	Michigan	Gwinn	do	249,428
57	Athens	do	Negaunee	do	247,869
58	Morris-Lloyd	do	Ishpeming	do	246,356
59	Shannon	Alabama	Birmingham	do	246,200
60	South Agnew	Minnesota	Buhl	do	246,116
61	Harold	do	Stuntz	do	231,669
62	Maas	Michigan	Negaunee	do	226,167
63	Wakefield	do	Wakefield	do	225,072
64	Bengal	do	Stambaugh	do	224,274
65	Penn group	do	Norway and Vulcan	do	219,665
66	Caspian	do	Caspian	do	216,900
67	Patrick	Minnesota	Pengilly	do	214,487
68	Utica	do	Hibbing	do	212,196
69	Maitland	Michigan	Negaunee	do	209,143
70	Imperial	do	Michigamme	do	207,774
71	Maroco	Minnesota	Ironton	do	204,793
72	Leetonia	do	Carson Lake	do	204,031
73	Warren	do	do	do	198,159
74	Lincoln	do	Virginia	do	190,992
75	Asteroid	Michigan	Ramsay	do	190,250
76	Tilden	do	Bessemer	do	190,209
77	Russellville	Alabama	Russellville	Brown ore	189,825
78	Union Hill (including Republic).	New Mexico	Fierro	Magnetite	184,472
79	Puritan	Michigan	Ironwood	Hematite	184,282
80	North Harrison	Minnesota	Pengilly	do	180,850
81	Rolling Mill	Michigan	Negaunee	do	179,573
82	Wanless	Minnesota	Buhl	do	173,642
83	Danube	do	Bovey	do	170,872
84	Hobart	do	Gilbert	do	164,200
85	Shenango	do	Chisholm	do	163,592

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1924—Continued

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
86	Monongahela	Michigan	Crystal Falls	Hematite	159,461
87	Attalla No. 1	Alabama	Attalla	do	154,762
88	Holmes	Michigan	Ishpeming	do	154,300
89	Ashland	do	Ironwood	do	154,098
90	Kerr	Minnesota	Hibbing	do	151,516
91	Balkan (including Judson)	Michigan	Alpha	do	145,903
92	Mary Charlotte	do	Negaunee	do	145,034
93	Iron Springs	Utah	Iron Springs	do	145,016
94	Hiawatha	Michigan	Iron River	do	143,820
95	Bristol	do	Crystal Falls	do	141,817
96	Homer	do	Iron River	do	137,826
97	La Rue	Minnesota	Nashwauk	do	136,100
98	Isabella	Michigan	Palmer	do	135,469
99	Carpenter	do	Crystal Falls	do	130,339
100	Philbin	Minnesota	Hibbing	do	129,619
101	Brunt	do	Mountain Iron	do	126,146
102	Odgers	Michigan	Crystal Falls	do	120,100
103	Sibley	Minnesota	Ely	do	119,160
104	Baker	Tennessee	Rockwood	do	118,731
105	Webb	Minnesota	Hibbing	do	116,944
106	Tobin	Michigan	Crystal Falls	do	116,400
107	Rogers	do	Iron River	do	114,379
108	Cambria (including Lillie)	do	Negaunee	do	110,631
109	Sunday Lake	do	Wakefield	do	109,811
110	French Creek	Pennsylvania	St. Peters	Magnetite	108,489
111	Irondale No. 2	Alabama	Irondale	Hematite	107,306
112	Shada	Minnesota	Nashwauk	do	106,955
113	Keweenaw	Michigan	Bessemer	do	101,311
114	Hillcrest	Minnesota	Ironton	do	101,173
115	Davidson No. 2	Michigan	Iron River	do	100,990
116	Mayville	Wisconsin	Mayville	do	100,066
117	Billings	Minnesota	Chisholm	do	100,043
	Total (117 mines)				50,230,333
	Output of 26 mines producing between 50,000 and 100,000 gross tons each				1,970,372
	Output of 117 mines producing less than 50,000 gross tons each				2,066,714
	Grand total of United States (260 mines)				54,267,419

STOCKS OF ORE AT MINES

According to the reports of producers the total quantity of iron ore in stock at the mines at the end of 1924 amounted to 12,410,619 gross tons, compared with 10,165,875 tons at the end of 1923, an increase of 22 per cent. As the quantity of ore in stock piles is of necessity partly estimated, there are variations in the mine reports from year to year which prevent an absolute balance between the quantity mined, the quantity shipped, and the stocks on hand. The reported stocks at the end of 1924 were about 610,000 tons above the average for the preceding five years.

Stock of iron ore at mines, by States, December 31, 1923 and 1924, in gross tons

State	1923	1924	State	1923	1924
Alabama	304,262	740,279	New York	498,901	441,492
Georgia	155	653	Pennsylvania	4,408	1,200
Iowa	12,165	12,165	Virginia	10,022	6,503
Michigan	6,279,090	7,399,505	Wisconsin	256,319	159,045
Minnesota	2,651,879	3,537,237			
Missouri	3,079	3,079		10,165,875	12,410,619
New Jersey	145,595	109,461			

VALUE OF IRON ORE PER TON

The table that follows gives the average value, at the mines, of the different classes of iron ore in 1923 and 1924 for each of the producing States or groups of States except where there were less than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These figures are taken directly from statements of the producers and probably represent the commercial selling prices only approximately, as all the reports are not consistent. Some of them evidently include merely mining costs; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others are the costs charged against the blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1923–24 [a]

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1923	1924	1923	1924	1923	1924
Alabama	$2.16	$2.06	$2.89	$2.74		
California					$6.74	(b)
Georgia	(b)	(b)	2.66	2.73		
Michigan	3.85	3.17				
Minnesota	3.55	3.00			(b)	(b)
Missouri	(b)	(b)	3.23	(b)		
Montana	(c)	(c)	[c] 2.88	[c] 2.77		
New Jersey			(b)	(b)	4.31	(b)
New York					4.49	$4.77
North Carolina			2.46	2.60	(b)	
Pennsylvania			(b)	(b)	2.28	2.32
Tennessee	(b)	(b)	2.86	(b)		
Virginia	(b)		3.27	2.73		
Wisconsin	2.91	2.60			(b)	(b)
Other States [d]	1.48	2.13	2.63	2.95	2.39	2.71
	3.46	2.91	2.88	2.75	3.34	2.95

[a] Carbonate of iron, used in making pig iron, was sold by one producer in Ohio in 1924.
[b] Less than three producers and permission to publish not given, therefore value may not be shown.
[c] Value for hematite included with brown ore.
[d] 1923: Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming. 1924: California, Colorado, Missouri, New Jersey, New Mexico, Tenneesse, Utah, Washington, and Wyoming.

The following table summarizes the average value of iron ore at mines beginning with 1913. Not until 1917 did the average value rise above $3 a ton, and the average for 1920, $4.11, is the highest on record.

Average value per gross ton of iron ore at mines in the United States, 1913–1924

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Hematite	Brown ore	Magnetite	Carbonate	General average [a]
1913	$2.21	$1.88	$2.07	$2.06	$2.19
1914	1.79	1.72	2.39	2.44	1.81
1915	1.80	1.80	2.50	2.44	1.83
1916	2.32	2.03	3.11	3.00	2.34
1917	3.12	2.95	4.29		3.15
1918	3.35	3.51	4.60		3.39
1919	3.48	3.63	4.08		3.50
1920	4.09	4.19	4.59	(b)	4.11
1921	3.37	2.63	3.61	(b)	3.37
1922	3.14	2.65	2.37	(b)	3.12
1923	3.46	2.88	3.34	(b)	3.45
1924	2.91	2.75	2.95	(c)	2.91

[a] Average values in 1889 and 1892–1912 are given in Mineral Resources for 1919 and many earlier volumes.
[b] Sold for paint and not included in shipments of iron ore.
[c] Carbonate of iron, used in making pig iron, was sold by one producer in Ohio in 1924; that from Pennsylvania was sold for paint.

LAKE SUPERIOR DISTRICT

PRODUCTION

The total quantity of iron ore mined in the Lake Superior district, not including the Iron Ridge area in Wisconsin, decreased 24 per cent in 1924. The output of the several ranges is shown below. After 1905 the figures do not include manganiferous iron ore containing more than 5 per cent of manganese; 787,253 gross tons of this ore was mined in 1924, compared with 1,330,640 tons in 1923. The Mesabi Range produced 66 per cent of the output of iron ore of the Lake Superior district and 55 per cent of the total output of the United States in 1924. The proportion produced by this range has been remarkably uniform since 1915, but it was slightly under the average in 1924. Production decreased in all the iron ranges except the Vermilion, which showed a small increase.

Iron ore mined in the Lake Superior district, 1854–1924, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1870	3,971,716						3,971,716
1871–1880	10,294,047	858,810					11,152,857
1881–1890	18,598,012	11,917,416	8,657,807	3,260,426			42,433,661
1891–1900	27,269,545	21,639,872	23,361,043	12,097,048	32,282,873		116,650,381
1901–1910	37,728,143	41,974,789	34,514,899	15,350,581	194,654,902		324,223,314
1911–1915	18,404,620	21,862,454	21,366,821	7,234,387	142,721,213	3,191,627	214,781,122
1916	4,792,987	6,649,578	7,707,101	1,704,440	41,325,341	1,555,641	63,735,088
1917	4,638,374	6,366,483	7,881,232	1,481,301	41,127,323	1,986,608	63,481,321
1918	3,946,554	6,041,637	7,837,634	1,192,677	39,055,977	1,705,315	59,779,794
1919	4,158,751	4,863,968	7,368,994	1,051,795	33,262,954	1,685,877	52,392,339
1920	4,457,609	5,651,542	8,298,206	1,053,518	36,641,880	1,757,775	57,860,530
1921	2,204,114	2,147,569	3,135,477	981,576	16,380,190	449,559	25,298,485
1922	2,745,626	3,290,641	4,910,789	1,108,764	26,704,601	955,595	39,716,016
1923	3,910,909	4,913,541	6,112,662	1,119,113	41,809,018	1,420,165	59,285,408
1924	3,579,087	3,780,664	5,579,883	1,141,690	29,818,965	941,430	44,841,719
	150,700,094	141,958,964	146,732,548	48,777,316	675,785,237	15,649,592	1,179,603,751

SHIPMENTS AND RECEIPTS

According to the Iron Trade Review, 43,895,110 gross tons of iron ore and manganiferous iron ore was shipped in 1924 from the Lake Superior district, including the Iron Ridge and Baraboo areas in Wisconsin, as compared with 60,780,003 tons in 1923. The shipments, as reported by producers to the division of mineral resources of the United States Geological Survey, prior to its transfer to the Bureau of Mines, amounted to 43,110,761 gross tons of iron ore and 787,253 gross tons of manganiferous iron ore containing 5 per cent or more of manganese—a total of 43,898,014 tons—compared with 59,453,026 tons of iron ore and 1,330,640 tons of manganiferous iron ore—a total of 60,783,666 tons—in 1923.

The iron ore received at Lake Erie ports amounted to 32,420,582 gross tons and at Lake Michigan ports, 9,202,099 gross tons—a total of 41,622,681 tons—compared with 44,568,186 tons at Lake Erie ports and 12,773,711 tons at Lake Michigan ports—a total of 57,341,897 tons—in 1923. Detailed figures of shipments and receipts by ports and by months for recent years can be found in the Marine Review.

STOCKS OF IRON ORE AT LAKE ERIE PORTS

Stocks of iron ore at lower Lake ports at the end of the shipping season are of importance because of their bearing on the manufacture of pig iron during the following winter and spring. At the close of navigation in 1924 there was 8,049,276 gross tons of ore in stock at Lake Erie ports, compared with 8,798,127 tons at the corresponding date in 1923.[3] At the opening of navigation in May, 1925, there was 4,303,062 gross tons of ore in stock at these ports, indicating a withdrawal of 3,746,214 tons during the winter of 1924–25. The average quantity withdrawn each winter during the preceding five winters was about 3,798,000 tons. Detailed statistics concerning these stocks, by ports, can be found in the Marine Review.

PRICES OF LAKE SUPERIOR IRON ORE

The price of iron ore per unit of iron in the natural state for the four standard grades of Lake Superior ore for the last 25 years is shown in the Iron Trade Review.[4] The base of old-range and Mesabi Bessemer ore is a metallic iron content of 55 per cent, natural, and for the old-range and Mesabi non-Bessemer ore 51.5 per cent, natural. The unit prices established April 4, 1924, are as follows: Old-range Bessemer, 11.364 cents; Mesabi Bessemer, 10.909 cents; old-range non-Bessemer, 10.680 cents; Mesabi non-Bessemer, 10.388 cents. The prices per ton that correspond to these unit prices are, respectively, $5.65, $5.40, $4.90, and $4.75 and are 80 cents lower than the prices prevailing during the shipping season of 1923. The prices for 1924 are the lowest that have been in effect since the season of 1916. The lowest prices ever quoted for these ores were $2.60 for old-range Bessemer in 1897, $2.15 for Mesabi Bessemer in 1895, $1.85 for old-range non-Bessemer in 1898, and $1.75 for Mesabi non-Bessemer in 1898.

[3] Marine Review.

[4] Iron Trade Review, Apr. 10, 1924, p. 1000.

IRON-ORE RESERVES

Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of State Tax Commissioners, including developed and prospective ore in the ground and ore in stock piles, show an increase of about 23,000,000 gross tons in Minnesota and a decrease of about 3,691,000 tons in Michigan. The Mesabi and Cuyuna Ranges in Minnesota and the Menominee Range in Michigan each showed increases in 1924.

Iron-ore reserves in Minnesota May 1, 1921–1924, in gross tons

Range	1921	1922	1923	1924
Mesabi	1, 273, 128, 664	1, 252, 820, 242	1, 254, 861, 451	1, 275, 347, 126
Vermilion	13, 150, 547	14, 354, 328	13, 688, 352	13, 169, 953
Cuyuna	25, 080, 590	29, 485, 159	43, 041, 100	46, 121, 021
	1, 311, 359, 801	1, 296, 659, 729	1, 311, 590, 903	1, 334, 638, 100

Iron-ore reserves in Michigan January 1, 1922–1925, in gross tons

Range	1922	1923	1924	1925
Gogebic	62, 405, 146	58, 314, 512	54, 949, 558	52, 026, 380
Marquette	72, 953, 551	72, 102, 521	70, 384, 149	68, 987, 647
Menominee (including Iron River and Crystal Falls districts)	64, 386, 025	66, 409, 915	66, 555, 393	67, 184, 024
	199, 744, 722	196, 826, 948	191, 889, 100	188, 198, 951

MINING DEVELOPMENTS

LAKE SUPERIOR DISTRICT [5]

General conditions.—The main features of the development of mining properties in the Lake Superior district in 1924 were the stripping of several large ore bodies and efforts to bring to a state of productivity certain deposits whose tonnage had already been determined by exploration. In the underground fields the deepening of shafts was general. Also there was a small amount of exploration by drilling, particularly in Michigan. Incidentally several old mines that have yielded many millions of tons of ore were practically exhausted during the year.

A tendency may, perhaps, be noted toward the consolidation and coordination of properties having different grades of ore so as to enrich or balance certain grades with one another and thus make possible the shipment of more uniform grades. Some companies provide for their present requirements through joint, or participating, interests in ore deposits. If agreements with the fee owners, however, require a large extraction of ore annually, the high-grade ore in a deposit may be rapidly depleted. This depletion, although temporarily advan-

[5] Details of many of the items mentioned herewith can be found in the following papers: Woodbridge D. E., Preparing for active year on ore ranges: Iron Age, Jan. 1, 1925, pp. 51–53. Hain, A. J., New era in iron-ore industry, trade outlook bright: Iron Trade Review, Jan. 1, 1925, pp. 35–39, 116. Woodbridge, D. E., Iron-ore mining: Eng. and Min. Jour.-Press, Jan. 17, 1925, pp. 36–37.

tageous to the fee owners, may not be conducive to the wisest utilization of the ore. Another element of disagreement is the demand of some fee owners, whose leases permit, that "merchantable" ore shall be construed to mean an ore carrying 52 per cent of iron, even though too high in silica to be sold at a profit.

In contradistinction to the Minnesota State and other local taxes levied on iron ores, which are regarded as excessive by the ore-mining companies, Ontario has decided to allow a bounty of 1 cent per unit of iron on all iron ore mined within the Province.

The year seems to have brought forth no outstanding developments in mining methods, but marked progress is reported in the electrification of mines, especially open pits. Some of the Mesabi ore deposits showed unexpected increases in silica content, which made necessary larger facilities for crushing and screening. Jigs similar to those used in concentrating the brown iron ores of Tennessee and Alabama and the zinc ores of southwest Missouri were introduced. Machines for screening and sintering certain Cuyuna Range ores have also been installed, and these new departures in the treatment of Lake Superior iron ores are regarded as promising. Larger ore cars, capacity 75 gross tons, and locomotives capable of hauling trains of 130 to 140 cars from ore fields to docks are being introduced. Large shovels have been installed in the mines; 325-ton electric shovels have been reported. In short, expenditures looking toward economy and efficiency in mining methods and equipment were continued, despite the depression in the industry.

Mesabi Range.—On the Mesabi Range the production in 1924 decreased 29 per cent, and amounted to about 91 per cent of the average for the preceding 10 years. Exploration does not seem to have been pushed vigorously, although the new ore discovered during the year was more than enough to keep pace with production. Shipments of ore were made from the new Mary Ellen, Helen, and Vernon mines. The Vernon mine, however, was exhausted during 1924, as were the Danube mine at Bovey, the Morrow mine at Eveleth, and the Belgrade mine at Biwabik.

Two significant facts have been brought out by the experiences of 1924. The first is that the magnetic separating plant, built at considerable cost to treat the lean magnetic ores of the eastern part of the range, was unable to operate under the market conditions. The plant is said to have been technically a success, but there was not enough demand for the high-grade sinter at prices at which it could be profitably sold. The second is that, in places in the western part of the Mesabi Range, the ores are becoming too siliceous to be successfully treated by the beneficiation methods heretofore in use. It is said that probably 100,000,000 tons of ore formerly considered merchantable, or practically so as mined, will now have to be treated, and new methods of washing may have to be devised. This unexpected discovery has resulted in the cancellation of leases on certain large mines; it has stimulated experimental work on the crushing and screening of ores; and has caused the installation at the Mary Ellen mine of the first jigging apparatus in the Lake Superior district.

The installation at the Wabigon mine has been reported as representing the first complete electrification of an open-cut mine. Several other mines are being electrified. Electrically operated shovels of the 325-ton type were used in stripping at the Bennett mine. The strip-

ping at the Scranton mine is said to have been one of the largest jobs ever accomplished, as the overburden was unusually deep—averaging 130 feet over an area of 80 acres—and approximately 8,000,000 cubic yards of material had to be removed. The capacity of the Minnewas and Missabe Mountain mines was greatly enlarged through stripping, and a new mine, the Morrison, near Coleraine, was being stripped. The Shada mine, formerly a comparatively small underground working, has been converted by stripping to a large open-pit mine with a supply of ore sufficient for five years without further stripping. Incidental to rendering more ore available, 26 houses at the townsite of Kerr, near Hibbing, were moved 3 miles, set on new foundations, connected with water and sewer, and made ready for occupancy in the short period of 49 days.

Vermilion Range.—The Vermilion was the only range to show a larger production, its output increasing 2 per cent in 1924. This output was about 91 per cent of the average for the preceding 10 years. Exploration did not keep pace with production. The Soudan, an underground mine that has been producing ore for about 40 years, is reported to be undergoing complete electrification.

Cuyuna Range.—On the Cuyuna Range the production of iron ore containing less than 5 per cent of manganese decreased 34 per cent in 1924, the output being about 70 per cent of the average of the 10 preceding years. The ore reserves credited to the Cuyuna Range apparently increased about 3,080,000 tons over those of 1923. The Kennedy mine at Cuyuna was reported to have been exhausted during 1924.

Coincident with the renewal of interest in manganiferous iron ore, such as can be supplied by the Cuyuna Range, it is reported that the Louise mine, formerly the Mille Lacs, has been the first underground manganiferous ore mine on this range to resume operations since the war. The Mahnomen and the Sagamore open-pit mines are credited with large shipments of manganiferous ore in 1924. The Sagamore has large electrically operated shovels for loading ore and for grading track and a large electric drag line for stripping.

A new feature in ore beneficiation has been introduced at the Evergreen mine at Crosby. The ore, which comprises both iron and manganiferous grades, is partly fine and partly coarse. It will be screened; the coarser part will be shipped directly; the finer material will be sintered to remove moisture and organic material and to convert a low-grade, dusty ore into a merchantable product.

The Soo line is reported to have begun the use of larger locomotives for hauling ore from the Cuyuna Range to the docks at Superior, Wis. These locomotives will be able to haul trains of 130 to 140 cars.

Early in 1924, a most serious and unusual disaster occurred at the Milford mine, where 41 men were killed by a rush of mud and water from a neighboring pond.

Marquette Range.—The production of ore on the Marquette Range decreased 8 per cent in 1924 and was about 94 per cent of the average for the preceding 10 years. The estimated ore reserves showed a decrease of about 1,397,000 tons at the end of the year, indicating that new discoveries did not keep pace with production. The Ford Motor Co. has continued exploration, but without favorable results so far as reported. The company requires much more ore than it produces and it is said to be negotiating for the purchase of

certain Cleveland-Cliffs properties. Aside from the Ford explorations a drilling campaign is reported to have been undertaken on a large tract of favorable land west of Ishpeming. At the Rolling Mill mine a plant for crushing to 3 inches all grades of ore produced from both underground and open-pit workings is reported available. The Salisbury and Francis mines are said to have been closed permanently.

Gogebic Range.—The production on the Gogebic Range decreased 9 per cent in 1924 and was about 89 per cent of the average of the preceding 10 years. In the Michigan part of the range the estimated ore reserves showed a decrease of about 2,923,000 tons. The Sunday Lake mine was reported as undergoing electrification, and several shafts, including that at Puritan, were deepened.

Menominee Range.—The production of ore on the Menominee Range decreased 23 per cent in 1924 and was about 78 per cent of the average for the preceding 10 years. In the Michigan part of the range the estimated reserves of ore increased slightly. Electrification of the Caspian and Baltic mines is said to have been completed and the installation of electric haulage at the Penn group of mines is reported under way.

Iron-ore analyses.—In April, 1925, the Lake Superior Iron Ore Association issued an interesting compilation of average analyses of Lake Superior iron ores for the 10 years 1915 to 1924. These analyses are arranged by grades of ore and by ranges and are summarized into a grand total. The tables show the tonnage shipped each year and the percentages of iron (natural), phosphorus, silica, manganese, and moisture. These tables show a remarkable uniformity in the composition of the ores. A few ores show a slight decrease in the content of iron and an increase in the content of phosphorus or silica, but in others the percentage of iron has increased and that of phosphorus or silica has decreased slightly over the 10-year period. For instance, in Menominee Range Bessemer ore (which forms only a very small proportion of the output of that range) the iron content has decreased about 3 per cent and the phosphorus has increased about 0.009 per cent. Gogebic Range Bessemer ore, on the other hand, has practically not changed. Mesabi Bessemer has increased nearly 2 per cent in iron, and has decreased 0.004 per cent in phosphorus and 0.10 per cent in silica. There are other interesting variations that lack of space precludes mentioning here, but the summaries of total tonnages, by ranges, and the grand total are perhaps the most significant. These summaries indicate that the iron content of Cuyuna and Marquette ores alone has decreased a few per cent in iron, and that the silica content of Marquette ore has increased perceptibly.

The grand total indicates little if any general change—the average iron content being 0.23 per cent higher in 1924 than in 1915, the phosphorus the same in the two years, the silica and the manganese only a fraction of a per cent higher, and the moisture a trifle lower. The highest iron content was in 1921, which was the year of smallest production.

The remarkable uniformity in these analyses does not, of course, indicate that the grade of the available Lake Superior iron ore is not declining. The grade has been maintained by methods of beneficiation, which are ever becoming more elaborate, to compensate for the

actual decline in quality, and by mixing ores from different deposits in order to promote uniformity in shipments to blast furnaces.

The following table, published by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore from the Cuyuna, Gogebic, Marquette, Menominee, and Mesabi Ranges, and shows the great uniformity in composition that has been maintained in the shipments during the last 10 years.

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1915–1924, inclusive

Year	Gross tons	Fe (natural)	P	SiO_2	Mn	Moisture
1915	45,883,488	51.19	0.100	8.14	0.64	11.29
1916	65,191,903	51.20	.097	8.00	.73	11.58
1917	62,521,465	51.40	.099	8.02	.76	11.57
1918	61,972,871	51.29	.104	8.12	.87	11.29
1919	46,666,878	51.57	.108	8.04	.73	11.34
1920	57,938,428	51.69	.103	8.13	.77	11.09
1921	22,523,989	52.07	.087	8.23	.62	10.95
1922	43,431,294	51.87	.099	8.23	.76	10.78
1923	60,024,176	51.79	.095	8.22	.79	10.76
1924	43,276,165	51.72	.100	8.45	.76	10.75

MISSOURI

The result of the effort to revive the iron-ore industry in Missouri is shown by a production of nearly 80,000 tons in 1924, all of which was shipped to blast furnaces at Granite City, Ill., and St. Louis, Mo. This production, however, was not adequate for the requirements of these furnaces; a much larger quantity of iron ore was obtained from mines in the Lake Superior district and from the Baraboo district in southern Wisconsin. The Iron Mountain mine, in St. Francois County, and the Rueppele mine, in Franklin County, supplied the greater part of the local ore; the remainder was produced from mines in Butler and Wayne Counties.

SOUTHEASTERN STATES

There was an increase of 3 per cent in the production of iron ore in Alabama in 1924, but less ore was mined in Georgia, North Carolina, and Tennessee. On October 1, 1924, the Sloss-Sheffield Steel & Iron Co. acquired the Alabama Co.'s iron-ore properties in Etowah, Jefferson, and Talladega Counties, Ala., and its blast furnaces at Gadsden and Ironaton, Ala.

NORTHEASTERN STATES

Adirondack district.—The Adirondack district showed a decrease of 57 per cent in production of iron ore in 1924. The output was small—only about 28 per cent of the average for the preceding 10 years and about one-eighth the capacity of the operating companies. Only three of the seven mines at Mineville and one mine at Lyon Mountain were in operation. Most of the ore mined in this district is concentrated magnetically, but a portion is shipped direct as mined.

WESTERN STATES

Utah.—The dream of an iron industry in Utah came true on May 1, 1924, when the blast furnace of the Columbia Steel Corporation at Provo, Utah, was blown in. The company draws its ore supply from deposits near Iron Springs, Utah.

FOREIGN TRADE IN IRON ORE

IMPORTS AND EXPORTS

The iron ore imported into the United States in 1924 decreased 26 per cent in quantity and 6 per cent in total value, as compared with 1923. The average value was $5.17 a ton in 1924 and $4.08 in 1923. Chile contributed 56 per cent of the ore imported, Sweden 16 per cent, and Cuba 14 per cent. The accompanying diagram (fig. 9) indicates the source and district of entry of the iron ore imported into the United States in 1924.

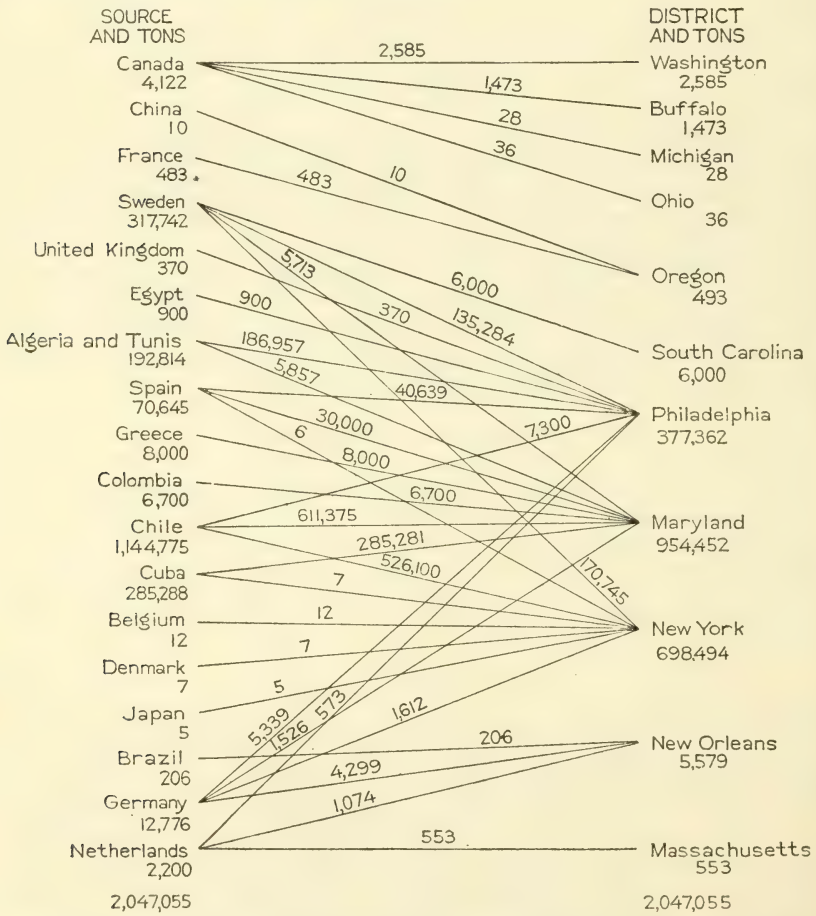

FIGURE 9.—Source and district of entry of iron ore imported into the United States in 1924. Figures for districts are preliminary, not final

Iron ore imported into the United States, 1922–1924

Country	1922		1923		1924	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Africa (French):						
Algeria and Tunisia	115,571	$330,182	345,367	$1,075,289	192,814	$546,803
Other	5,000	14,484				
Belgium					12	75
Brazil			70	262	206	3,058
Canada	2,840	10,439	24,710	97,700	4,122	15,705
Chile	259,547	1,625,332	634,600	3,704,159	1,144,775	7,479,683
China	(a)	2	2,968	8,809	10	35
Colombia			19,000	76,000	6,700	20,100
Cuba	381,746	1,580,504	692,979	2,780,131	285,288	1,141,155
Denmark					7	114
Dominican Republic					(a)	2
Egypt	885	23,685	13,000	92,233	900	21,288
France			128	2,741	483	11,418
Germany	2,906	14,709	16,013	80,919	12,776	57,070
Greece			15,300	23,339	8,000	14,230
Hongkong	1	58				
Italy			1	5		
Japan					5	136
Kwangtung	24	79	1	15		
Mexico					(a)	5
Netherlands			1,067	5,425	2,200	6,692
Newfoundland and Labrador	1	5	33,240	120,119		
Norway			4,931	32,559	(b)	25
Spain	47,111	242,783	214,891	503,258	70,645	179,875
Sweden	317,539	1,054,992	749,765	2,695,612	317,742	1,074,672
United Kingdom	580	13,142	399	9,928	370	8,763
Venezuela	1,400	5,838				
Virgin Islands of the United States	5	60				
	1,135,156	4,916,294	2,768,430	11,308,503	2,047,055	10,580,904

[a] Less than 1 ton. [b] Not recorded.

Iron ore imported into the United States, 1872–1924

Year	Gross tons	Year	Gross tons	Year	Gross tons
1872–1880	1,188,267	1917	971,663	1923	2,768,430
1881–1890	7,663,630	1918	787,468	1924	2,047,055
1891–1900	5,869,757	1919	476,461		
1901–1910	11,798,568	1920	1,273,456		46,824,362
1911–1915	9,202,947	1921	315,768		
1916	1,325,736	1922	1,135,156		

Exports of iron ore from the United States in 1924 amounted to 595,413 gross tons, valued at $2,407,003, or $4.04 a ton, compared with 1,116,932 tons, valued at $5,305,365, or $4.75 a ton, in 1923. These figures represent a decrease of 47 per cent in quantity and 55 per cent in total value. Except 31 tons to Mexico, all the ore exported in 1924 went to Canada.

Iron ore exported from the United States, 1899–1924, in gross tons

Year	Quantity	Year	Quantity
1899–1900	92,125	1920	1,145,037
1901–1910	2,713,397	1921	440,106
1911–1915	4,265,538	1922	602,194
1916	1,183,952	1923	1,116,932
1917	1,132,313	1924	595,413
1918	1,256,383		
1919	996,569		15,539,959

IRON-ORE MINING IN CUBA

The iron ore shipped from Cuba to the United States in 1924 amounted to 294,555 gross tons, valued at $1,145,327, compared with 674,371 tons, valued at $2,737,946, in 1923—a decrease of 56 per cent in quantity and 58 per cent in total value. The average value of the ore was $3.89 a ton in 1924; in 1923 it was $4.06. The shipments in 1924 were 96 per cent of hematite, including a little magnetite, from the Daiquiri and Juragua mines, on the southern coast, and 4 per cent of brown ore from the Mayari mines, near the northern coast. In 1924 the iron content of the hematite, dried at 212° F., was 58.57 per cent, and the brown ore carried 52.46 per cent (natural) and 54.25 per cent (nodulized); in 1923 the hematite (natural) averaged 58.31 per cent iron.

The total stock of ore (natural and nodulized) reported on hand at the end of 1924 was 1,009,963 gross tons, compared with 773,390 tons at the end of 1923—an increase of 31 per cent.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the shipments of Cuban iron ore were collected by the division of mineral resources of the United States Geological Survey prior to the transfer of that division to the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1924, in gross tons

Year	Juragua (hematite and magnetite)	Sigua (hematite)	Daiquiri (hematite and a little magnetite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1890	1, 142, 519						1, 142, 519
1891–1900	[a] 2, 348, 473	20, 438	[b] 979, 992				3, 348, 903
1901–1910	2, 104, 186		[c] 4, 456, 440	307, 700	41, 241	224, 729	7, 134, 296
1911–1915	1, 567, 112		1, 837, 669	1, 855, 525		532, 194	5, 792, 500
1916	212, 013		181, 602	258, 451		60, 650	712, 716
1917	39, 784		181, 028	287, 904		44, 769	553, 485
1918	17, 128		353, 103	232, 540		40. 761	643, 532
1919			279, 700	78, 080			357, 780
1920	[d]		[d] 561, 268	321, 515			882, 783
1921	[d]		[d] 130, 359				130, 359
1922	[d]		[d] 444, 794				444, 794
1923	[d]		[d] 674, 371				674, 371
1924	[d]		[d] 283, 094	11, 461			294, 555
	[d] 7, 431, 215	20, 438	[d] 10, 363, 420	3, 353, 176	41, 241	903, 103	22, 112, 593

[a] Of this quantity, 5,932 tons was sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons was sent to ports outside of the United States.
[c] Of this quantity, 12,691 tons was sent to ports outside of the United States.
[d] Shipments of Juragua mines, 1920–1924, included with Daiquiri mines.

PRODUCTION OF IRON ORE, BY COUNTRIES

The following table, compiled by L. M. Jones, of the Bureau of Mines, shows the production of iron ore by countries for 1920 to 1924, as far as it has been possible to obtain figures. For preceding years, see earlier volumes of Mineral Resources. How the United States predominates as a producer of iron ore is well illustrated by its yielding annually about one-half of the world's output.

Iron ore produced, 1920–1924, by countries, in metric tons

Country	1920	1921	1922	1923	1924
North America:					
Canada [a]	117,092	53,985	16,303	27,904	[b]
Cuba [a]	896,952	132,451	451,933	685,195	299,283
Newfoundland [a]	590,850	522,456	1,014,490	936,369	665,633
United States	68,689,517	29,964,308	47,884,940	70,464,533	55,138,411
South America:					
Brazil (exports)	17			350	[b]
Chile [c]		48,393	222,947	679,187	987,969
Europe:					
Austria	435,062	710,932	1,112,415	1,211,065	713,805
Belgium	17,260	59,490	71,250	117,090	154,970
Czechoslovakia	1,053,124	800,829	313,149	675,185	1,173,935
Finland	12,893		1,187	1,000	[b]
France	13,921,800	14,200,937	21,106,112	23,428,160	28,992,241
Germany	6,354,344	5,903,190	5,922,698	5,107,731	4,453,547
Greece	45,579	54,925	49,272	100,115	99,787
Hungary	101,665	36,015	45,909	[b]	[b]
Italy	389,876	279,478	311,214	340,831	218,726
Luxemburg	3,704,390	3,031,626	4,488,974	4,097,549	5,333,580
Norway	79,268	54,975	268,815	385,836	522,124
Poland	120,000	241,293	352,531	450,175	289,281
Portugal	12,845	10,370	18,292	9,145	8,573
Rumania [d]	79,839	91,109	94,607	99,293	102,537
Russia	170,356	170,356	220,775	493,376	[e] 913,823
Spain	4,767,693	2,602,369	2,771,888	3,456,233	4,612,817
Sweden	4,519,112	6,464,347	6,201,243	5,588,173	6,499,730
Switzerland	[b]	28,000	47,000	76,000	[b]
United Kingdom	12,910,840	3,533,776	6,977,736	11,049,758	11,227,951
Yugoslavia	1,130	16,357	35,645	244,619	330,119
Asia:					
China	1,489,731	1,270,000	1,371,000	1,401,000	1,100,000
Chosen	454,427	242,225	185,560	243,279	309,443
India	566,961	957,204	635,310	834,231	1,468,510
Indo-China	2,376				
Japan	203,559	19,935	[b]	[b]	[b]
Unfederated Malay States		75,442	113,154	156,635	257,181
Africa:					
Algeria	1,071,278	720,840	1,045,816	1,452,563	1,622,506
Belgian Congo	79,732	73,215	71,305	105,756	105,195
Madagascar	34	44	24		
Morocco	211,886	[f] 115,457	300,084	396,705	[b]
Tunisia	406,280	265,736	496,762	845,000	797,680
Union of South Africa	2,326	2,192	1,913	521	
Oceania:					
Australia—					
New South Wales [g]	165,820	181,839	115,152	181,309	147,793
Queensland	20,025	4,126		203	
South Australia	419,667	515,130	52,248	390,604	589,622

[a] Shipments.
[b] Data not available.
[c] From Tofo mine.
[d] Fiscal year Apr. 1 to Mar. 31.
[e] Year ended Sept. 30, 1924.
[f] Exports from Melilla.
[g] Includes iron oxide used for paint and ironstone.

BENEFICIATED IRON ORE

The processes reported as employed in 1924 to improve the quality of the ore at the mines were crushing and screening, drying by direct heat and by steam, hand picking on tables and on belts, washing by means of hydraulic jets and logs, jigging, electromagnetic separation, sintering, calcining, nodulizing, and desulphurization by sintering. Some of the operations combined two or more of these processes. Beneficiation of iron ores was reported at 71 mines in 11 States in 1924 and at 90 mines in 12 States in 1923. Some iron ore is also recovered in the form of dust from blast furnaces, but no statistics on it have been gathered. Ore so recovered was originally included in the statistics of shipments from the mines.

The total beneficiated ore reported shipped from mines in the United States in 1924 decreased 34 per cent in quantity and 42 per

cent in value, as compared with 1923. From such figures as are available to show the relation between crude ore treated and beneficiated ore recovered, it is evident that in washing brown ore the ratios, by weight, of crude ore washed to resultant concentrates range from 5 : 1 to 1.993 : 1; in concentrating hematite, from 2.423 : 1 to 1.050 : 1; in magnetite, from 2.757 : 1 to 1.112 : 1; and in carbonate, 1.334 : 1.

Figures for the quantity of crude iron ore treated and of beneficiated ore recovered therefrom in the Lake Superior district in 1924 are available. The quantity of crude ore beneficiated in the district in 1924 amounted to 7,790,428 gross tons, and the beneficiated ore recovered was 5,172,161 tons—a reduction of 2,618,267 tons, and a ratio of 1.506 : 1.

Beneficiated iron ore shipped from mines in the United States, 1923–24

State	Variety	1923		1924	
		Gross tons	Value	Gross tons	Value
Alabama	Hematite, brown ore	1,003,247	$2,938,692	751,774	$2,004,161
Georgia	Brown ore	89,584	238,591	59,754	168,288
Michigan	Hematite	56,445	(a)	24,946	(a)
Minnesota	Hematite, magnetite	7,571,939	25,690,872	5,134,264	15,055,757
Missouri	Hematite, brown ore	28,674	136,825	56,847	315,622
New Jersey	Magnetite, brown ore	309,252	1,332,398	100,167	(a)
New York	Magnetite	656,192	2,971,996	257,506	1,274,367
North Carolina	Brown ore	11,399	(a)	11,425	30,081
Pennsylvania	Magnetite	626,392	(a)	439,473	(a)
Tennessee	Hematite, brown ore	202,553	501,834	143,846	347,908
Virginia	do	129,229	483,274	22,895	61,687
Wisconsin	Magnetite	2,086	(a)	700	(a)
Undistributed			3,071,029		2,319,008
		10,686,992	37,365,511	7,003,597	21,576,879

[a] Included under "Undistributed."

IRON AND STEEL

The records of the production and sales of iron and steel shown in the following pages are derived in part from producers who report directly to the Bureau of Mines (formerly to the United States Geological Survey), and in part from several other authoritative sources, such as the American Iron and Steel Institute, Metal Statistics, the Iron Age, and the Iron Trade Review. The statistics on imports and exports are from the Bureau of Foreign and Domestic Commerce.

PIG IRON

SHIPMENTS, VALUE, AND PRODUCTION, BY STATES

The shipments of pig iron, exclusive of ferro-alloys, reported by the manufacturers to the division of mineral resources of the United States Geological Survey before its transfer to the Bureau of Mines, represent a decrease of 19 per cent in quantity and 30 per cent in value as compared with 1923. The values stated represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items which are figured in some of the market prices of pig iron as published in the trade journals.

The pig iron shipped includes the metal produced from foreign as well as from domestic ore. The pig iron derived from ore imported from Africa, Algeria, Brazil, Canada, Chile, Cuba, Greece, Newfoundland, Spain, and Sweden, although it constitutes a very small percentage of the total production, amounted in 1924 to 1,330,868 gross tons, valued at $27,539,725, as compared with 1,178,756 tons, valued at $33,376,286, in 1923. In the manufacture in 1924 of 1,284,860 gross tons of pig iron, 2,072,002 gross tons of foreign ore, including 59,313 tons of cinder derived from foreign pyrite, was reported to have been used, thus indicating an average pig-iron yield of 62.01 per cent from imported ore. Domestic ore and 4,587,007 gross tons of cinder, scale, and scrap, amounting in all to 56,467,569 gross tons, was reported used in the manufacture of 29,584,339 tons of pig iron, thus indicating a yield of 52.39 per cent in pig iron from domestic materials. The total production of pig iron, exclusive of ferro-alloys, reported to the division of mineral resources was 30,869,199 gross tons, compared with 39,767,482 tons in 1923, a decrease of 22 per cent.

Pig iron shipped from blast furnaces in the United States, 1923–24, by States

State	1923		1924		Percentage of increase or decrease	
	Gross tons	Value	Gross tons	Value	Quantity	Value
Alabama	2,784,625	$64,912,809	2,667,361	$55,791,228	−4	−14
Colorado	[a]	[a]	[a]	[a]		
Illinois	3,741,002	94,878,917	2,695,961	59,299,519	−28	−37
Indiana	3,021,504	70,270,894	2,571,411	52,507,720	−15	−25
Kentucky	154,680	[a]	99,055	[a]	−36	
Maryland	489,137	[a]	539,188	[a]	+10	
Massachusetts	1,667	[a]	50	[a]	−97	
Michigan	717,279	18,827,808	650,333	15,225,990	−9	−19
Minnesota	418,726	[a]	189,033	[a]	−55	
Missouri	4,513	[a]	21,371	[a]	+374	
New Jersey	[a]	[a]	[a]	[a]		
New York	2,426,522	57,543,779	1,914,545	38,150,486	−21	−34
Ohio	8,964,805	222,009,553	7,434,487	159,701,131	−17	−28
Pennsylvania	13,898,624	347,679,274	10,962,288	237,052,035	−21	−32
Tennessee	215,009	5,793,756	126,660	2,782,154	−41	−52
Utah			[a]	[a]		
Virginia	238,742	6,389,149	94,462	2,268,022	−60	−65
West Virginia	506,543	12,499,112	453,944	9,884,019	−10	−21
Wisconsin	280,457	7,264,981	172,435	3,945,369	−39	−46
Undistributed	[b] 497,544	[b] 38,729,346	[b] 471,545	[b] 28,471,299		
	38,361,379	946,799,378	31,064,129	665,078,972	−19	−30

[a] Included under "Undistributed."

[b] Includes figures for States marked "(a)".

Pig iron shipped from blast furnaces in the United States, 1923–24, by grades

Grade	1923			1924		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	253, 544	$7, 834, 835	$30. 90	172, 196	$4, 596, 697	$26. 69
Foundry	5, 492, 429	137, 330, 641	25. 00	5, 094, 594	107, 434, 288	21. 09
Basic	19, 699, 027	468, 716, 847	23. 79	16, 238, 122	339, 123, 530	20. 88
Bessemer	10, 993, 132	281, 730, 764	25. 63	7, 958, 929	178, 176, 837	22. 39
Low-phosphorus	209, 014	6, 350, 833	30. 38	209, 941	5, 379, 655	25. 62
Malleable	1, 343, 370	35, 338, 854	26. 31	1, 042, 110	22, 234, 248	21. 34
Forge	268, 217	6, 802, 884	25. 36	247, 545	5, 341, 975	21. 58
All other (not ferro-alloys)	102, 646	2, 693, 720	26. 24	100, 692	2, 791, 742	27. 73
	38, 361, 379	946, 799, 378	24. 68	31, 064, 129	665, 078, 972	21. 41

The American Iron and Steel Institute reports that the output in 1924 of all kinds of pig iron, including ferro-alloys, produced in blast furnaces, as well as some that was electrically produced, decreased 8,955,356 tons, or 22 per cent, as compared with 1923.

Pig iron, including ferro-alloys, manufactured in the United States, 1923–24, in gross tons [a]

State	1923	1924	State	1923	1924
Pennsylvania	14, 804, 620	11, 068, 979	Missouri		
Ohio	9, 347, 960	7, 415, 039	Iowa		
Illinois	3, 839, 063	2, 600, 864	Colorado	321, 436	463, 573
Alabama	2, 797, 190	2, 773, 825	Utah		
Indiana	3, 813, 125	3, 350, 385	Washington		
Michigan			Maryland	529, 606	558, 420
New York	2, 951, 810	2, 013, 673	Tennessee	250, 982	137, 991
New Jersey			Massachusetts	278, 183	97, 739
Wisconsin	724, 717	357, 271	Virginia		
Minnesota				40, 361, 146	31, 405, 790
West Virginia	702, 454	568, 031			
Kentucky					

[a] American Iron and Steel Institute.

AVERAGE VALUES

Values at blast furnaces.—The average value of all kinds of pig iron given in the following table is based on reports of the manufacturers to the division of mineral resources. The figures represent the approximate values f. o. b. at the blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces, exclusive of ferro-alloys, showed a decrease of 13 per cent for 1924.

Average value per gross ton of pig iron at blast furnaces in the United States, 1919–1924

State	1919	1920	1921	1922	1923	1924
Alabama	$25.96	$32.70	$24.33	$19.29	$19.72	$20.92
Illinois	24.42	28.02	24.50	21.60	25.36	22.00
Indiana	22.51	25.58	22.32	19.65	23.26	20.42
Kentucky	30.06	31.72	28.77	21.05	[a]	[a]
Michigan	32.23	36.22	29.64	24.83	26.25	23.41
Missouri	33.40	45.04	28.19	[a]	[a]	[a]
New Jersey	31.48	38.23	[a]	[a]	[a]	[a]
New York	26.84	37.02	23.15	22.11	23.71	19.93
Ohio	25.59	29.93	24.24	22.17	24.76	21.48
Pennsylvania	25.86	33.27	24.43	22.77	25.02	21.62
Tennessee	33.10	42.55	27.12	21.65	26.95	21.97
Virginia	31.53	41.21	30.24	25.59	26.76	24.01
West Virginia	25.04	32.53	25.29	24.32	24.68	21.77
Wisconsin	29.42	33.98	29.15	23.75	25.90	22.88
Other States [b]	25.92	33.87	25.50	22.11	24.73	21.57
Average for United States	25.75	31.95	24.28	21.98	24.68	21.41

[a] Included under "Other States."

[b] 1919: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Texas, and Washington. 1920: Colorado, Connecticut, Maryland, Massachusetts, and Minnesota. 1921: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, and New Jersey. 1922: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Missouri, and New Jersey. 1923: Colorado, Kentucky, Maryland, Massachuetts, Minnesota, Missouri, and New Jersey. 1924: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and Utah.

Average value per gross ton of pig iron at blast furnaces in the United States, 1889–1924

1889	$15.78	1898	$9.90	1907	$20.56	1916	$16.96
1890	16.43	1899	18.00	1908	15.96	1917	27.29
1891	15.50	1900	18.85	1909	16.25	1918	30.89
1892	14.32	1901	15.25	1910	15.45	1919	25.75
1893	11.90	1902	20.92	1911	14.07	1920	31.95
1894	9.76	1903	19.12	1912	13.93	1921	24.28
1895	11.14	1904	14.13	1913	15.08	1922	21.98
1896	10.47	1905	16.63	1914	13.42	1923	24.68
1897	9.85	1906	19.98	1915	13.21	1924	21.41

Commercial quotations.—The average monthly prices, according to published market quotations, of the chief grades of pig iron, either at the blast furnaces or at the nearest market, in 1923 and 1924, are summarized in the following table for comparison with figures reported by blast-furnace operators as shown in the preceding tables. The average commercial quotations for each of the four grades of iron show a decrease and are higher than the average values reported by the manufacturers; in comparing these figures the reader should remember that the manufacturers' values represent weighted averages of what was actually received by them for the metal and that a discrepancy is to be expected between the two sets of figures. Commercial quotations of prices of basic pig iron for the last seven years are shown graphically in Figure 10, which brings out the contrast between the high and low prices more markedly than a table would.

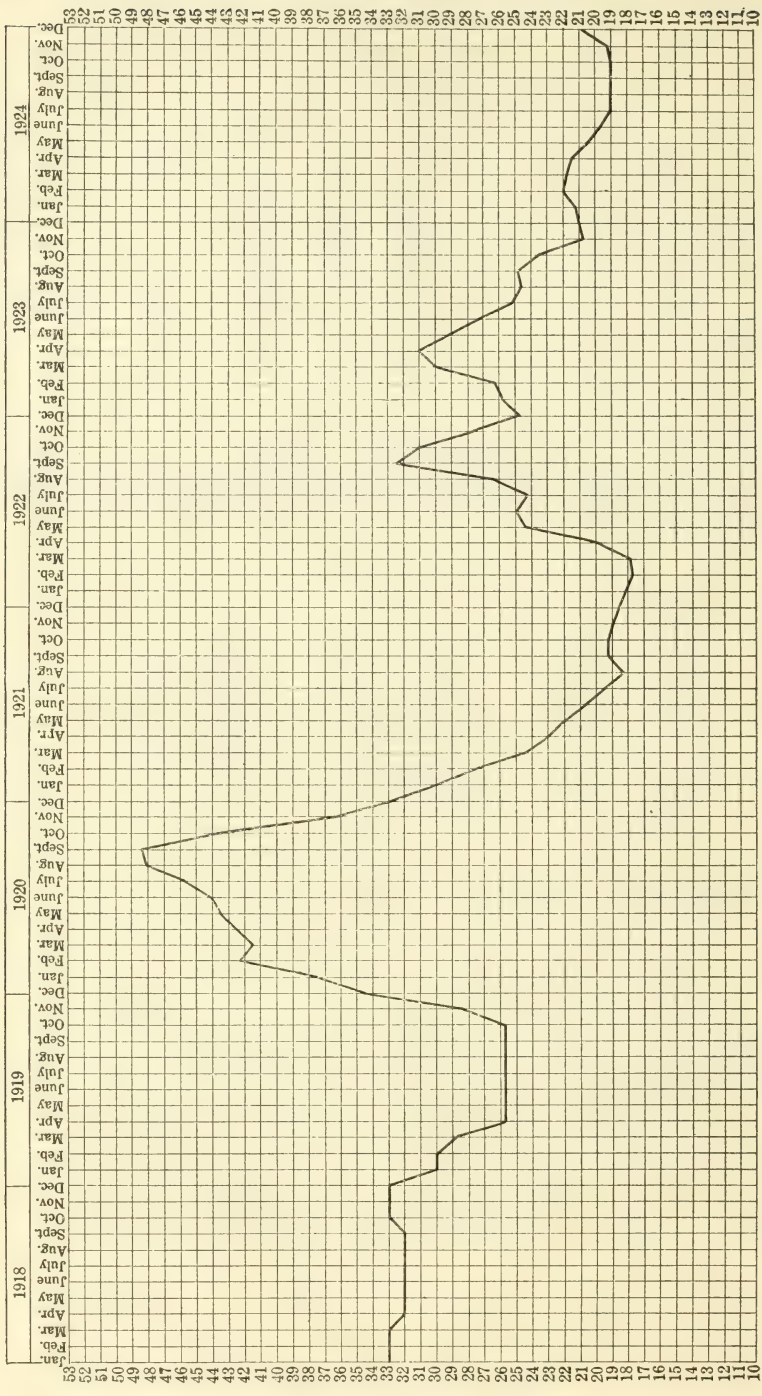
DOLLARS PER GROSS TON
53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10
1918
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1919
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1920
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1921
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1923
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1924
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIGURE 10.—Commercial quotations of basic pig iron at blast furnaces in Mahoning and Shenango Valleys, Ohio and western Pennsylvania, 1918–1924, by months (Statistics from the Iron Age, Jan. 1, 1925, p. 71).

Average monthly prices per ton of principal grades of pig iron, 1923–24 [a]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1923	1924	1923	1924	1923	1924	1923	1924
January	$27.00	$22.12	$23.23	$21.27	$27.50	$23.00	$25.00	$21.12
February	27.21	23.30	24.29	22.52	27.75	23.72	25.67	22.62
March	30.00	23.00	26.33	22.50	29.94	23.29	29.44	22.00
April	31.00	22.04	27.00	22.35	31.00	22.87	31.00	21.54
May	30.69	21.15	27.00	21.46	30.23	22.25	29.33	20.73
June	28.04	19.72	25.63	19.88	28.73	21.32	26.85	19.48
July	25.70	19.00	25.00	17.75	26.82	20.27	25.12	19.00
August	25.00	19.23	23.37	17.50	26.50	20.00	25.00	19.00
September	24.96	19.92	22.81	17.50	26.50	20.00	24.92	19.00
October	23.76	19.50	20.11	17.50	25.33	20.00	24.00	19.00
November	21.84	19.44	19.04	17.81	23.82	20.17	21.20	18.85
December	21.96	21.10	20.36	19.71	23.00	21.58	20.96	20.40
Average	26.43	20.79	23.68	19.81	27.26	21.54	25.71	20.23

[a] Metal Statistics, 1925.

DAILY AVERAGE PRODUCTION

The daily average production of coke and anthracite pig iron, by months, during the last seven years is graphically illustrated in Figure 11. The curves of prices and production show little similarity until the latter part of 1920, when the laws of demand and supply began to operate more normally than in the preceding four or five years.

PRODUCTION BY GRADES AND BY FUEL USED, TOTAL PRODUCTION, AND BLAST FURNACES

The statistics of production of pig iron by grades and by fuel used for 1920–1924, the total production of pig iron, and the number of furnaces in blast in 1923–24 have been published by the American Iron and Steel Institute as given below. These figures include ferroalloys. Metals produced by use of electricity and by use of coke and electricity together are included in coke pig iron.

Pig iron manufactured in the United States, 1920–1924, by grades, in gross tons

Grade	1920	1921	1922	1923	1924
Bessemer and low-phosphorus	12,062,084	5,595,215	7,813,263	11,677,509	8,172,297
Basic	16,737,722	7,753,071	13,841,367	19,795,590	15,999,012
Forge	318,048	112,748	214,210	327,430	255,961
Foundry and ferrosilicon	5,957,782	2,568,136	3,976,431	6,470,013	5,623,124
Malleable	1,310,951	457,340	1,051,495	1,571,064	973,158
Spiegeleisen	111,449	56,423	73,443	129,686	107,066
Ferromanganese	295,447	103,755	150,115	247,031	194,243
White, mottled, direct castings, etc	132,504	41,438	99,640	142,823	80,929
	36,925,987	16,688,126	27,219,904	40,361,146	31,405,790

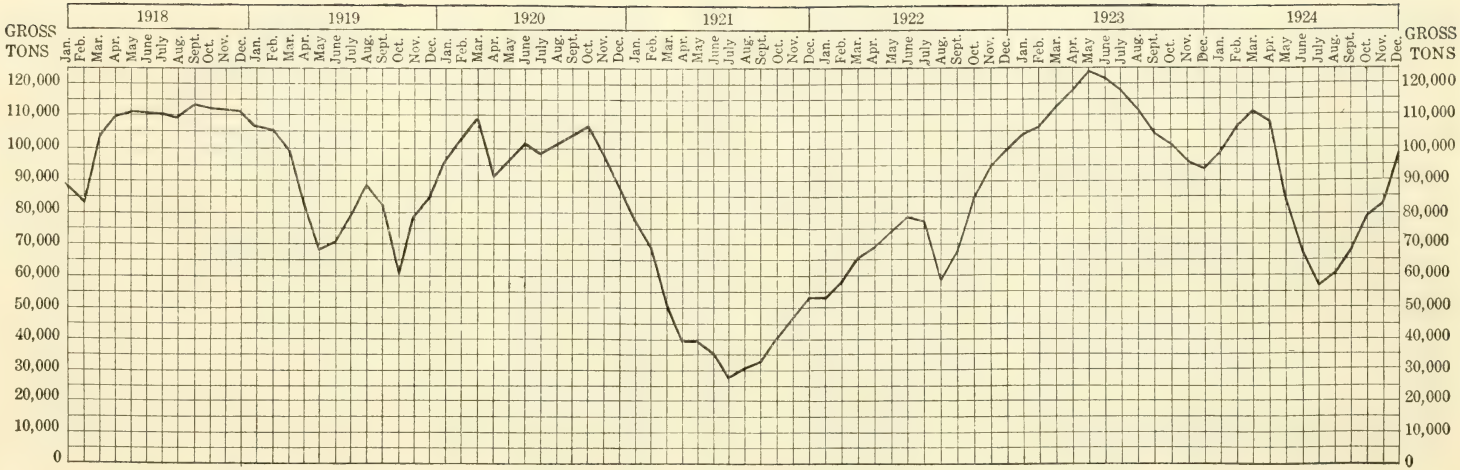

FIGURE 11.—Daily average production of coke and anthracite pig iron in the United States, 1918–1924, by months
(Statistics from the Iron Age, Jan. 8, 1925, p. 152)

Pig iron manufactured in the United States, 1920–1924, by fuel used, in gross tons

Fuel used	1920	1921	1922	1923	1924
Bituminous, chiefly coke	36, 300, 024	16, 579, 653	26, 995, 173	40, 097, 239	31, 193, 080
Anthracite and coke	302, 567	13, 743		12, 730	
Charcoal	323, 396	94, 730	224, 731	251, 177	212, 710
	36, 925, 987	16, 688, 126	27, 219, 904	40, 361, 146	31, 405, 790

The next table shows the production in the United States of pig iron, including the commoner ferro-alloys, so far as has been recorded. Statistics by years prior to 1916 will be found in Mineral Resources for 1918 and earlier years.

Pig iron manufactured in the United States, 1810–1924

Year	Gross tons	Year	Gross tons	Year	Gross tons
1810–1860	10, 542, 548	1911–1915	137, 591, 093	1921	16, 688, 126
1861–1870	11, 366, 963	1916	39, 434, 797	1922	27, 219, 904
1871–1880	24, 055, 278	1917	38, 621, 216	1923	40, 361, 146
1881–1890	56, 902, 041	1918	39, 054, 644	1924	31, 405, 790
1891–1900	98, 124, 754	1919	31, 015, 364		
1901–1910	211, 321, 934	1920	36, 925, 987		850, 631, 585

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1923 and 1924, not including any electric reduction furnaces, are as follows:

Blast furnaces in the United States, 1923 and 1924

State	In blast June 30, 1923	Dec. 31, 1923			In blast June 30, 1924	Dec. 31, 1924		
		In	Out	Total		In	Out	Total
Pennsylvania	125	87	63	150	55	87	59	146
Ohio	67	48	29	77	30	49	28	77
Illinois	24	17	9	26	8	18	8	26
Alabama	30	23	20	43	24	23	19	42
New York	24	18	10	28	9	15	12	27
Virginia	6	3	14	17	1	3	14	17
Tennessee	7	2	15	17	3	2	13	15
Colorado	3	2	3	5	3	2	3	5
Missouri			3	3	1		3	3
Utah					1	1		1
Maryland	5	4	2	6	2	5	1	6
New Jersey	2	2	2	4			4	4
Wisconsin	5	1	6	7	2	1	6	7
Minnesota	3	3		3	1	1	2	3
Indiana	16	14	2	16	10	14	2	16
Michigan	12	11	2	13	10	10	3	13
West Virginia	4	3	1	4	3	3	1	4
Kentucky	2	1	6	7	1	1	6	7
Georgia			1	1			1	1
Texas			1	1			1	1
Mississippi			1	1			1	1
Connecticut			2	2			2	2
Massachusetts			1	1			1	1
	335	239	193	432	164	235	190	425

FOREIGN TRADE IN PIG IRON

The quantity of pig iron imported into the United States in 1924 decreased 43 per cent, compared with 1923.

Pig iron, including kentledge, ferromanganese, ferrosilicon, and spiegeleisen, 1920–21, and pig iron, 1922–1924, imported into the United States, in gross tons [a]

Country	1920	1921	1922	1923	1924
North America:					
Canada	101,071	9,651	17,836	54,076	15,933
Honduras					200
Mexico				1	
Newfoundland and Labrador		13			
Panama			141		
South America: Brazil	466				
Europe:					
Austria				299	
Belgium		12,004	64,449	14,980	3,019
France	5	127	41,704	57,722	23,208
Germany		3,508	4,085	20,740	11,228
Netherlands			2,537		23,857
Sweden	105	1,088	408	705	700
Switzerland		10			
United Kingdom—					
England	64,008	9,302	152,833	179,937	52,593
Ireland					50
Scotland	10,208		98,950	18,201	4,546
Asia:					
China	3,555	4,610	502	3,129	2,375
Hongkong		250			
India (British)	1,977			17,988	71,370
Japan	3,851	2,002			
Kwangtung	200	1,213			30
Oceania: Australia	498	258			
	185,944	44,036	383,445	367,778	209,109
Value	$12,801,834	$2,014,926	$8,670,860	$9,005,077	$3,741,213

[a] Separate figures for pig iron not available prior to 1922.

The pig iron exported from the United States in 1924 increased 28 per cent in quantity and 11 per cent in value, as compared with 1923. Canada was the best customer in 1924, having taken 60 per cent of the total pig iron exported. The average value was $23.09 a ton in 1924, as compared with $26.69 in 1923.

Pig iron exported from the United States, 1923–24, in gross tons

Country	1923	1924	Country	1923	1924
North America:			Europe—Continued.		
Canada	20,727	25,010	France	10	60
Cuba	660	610	Germany	623	715
Mexico	494	987	Norway	10	45
Panama	46	693	Sweden	25	
Other countries	196	106	United Kingdom—		
South America:			England	7,442	9,778
Argentina	75	32	Scotland		99
Brazil	10	123	Asia:		
Chile	450		China	170	
Colombia	415	422	Japan	80	62
Peru	298	279	Philippine Islands	9	55
Other countries	27	95	Other countries		2
Europe:				32,318	41,483
Austria		34	Value	$862,443	$957,921
Belgium	551	2,276			

PRODUCTION BY COUNTRIES

In compiling the table of production of pig iron by countries since the war, it has been necessary to use such statistics as are available and to revise figures from year to year as more complete and reliable data are obtained. For a time figures for the normal year 1913 were given for comparison, but changes in boundaries of countries in Europe have rendered comparisons with pre-war figures confusing. The predominant position of the United States in pig-iron production is well shown, and the table in connection with that of exports from the United States indicates that the consumption in the principal European countries is still very moderate. This table was compiled by L. M. Jones, of the Bureau of Mines.

Pig iron (including ferro-alloys) produced, 1920–1924, by countries, in metric tons

Country	1920	1921	1922	1923	1924
Australia	349, 521	358, 020	84, 874	335, 096	422, 728
Austria	99, 766	224, 031	320, 928	341, 875	266, 463
Belgium	1, 116, 400	872, 010	1, 497, 610	2, 147, 950	2, 843, 920
Brazil	[a]	17, 700	[a]	[b] 70, 000	[b] 70, 000
Canada	1, 014, 743	626, 199	410, 192	923, 362	629, 366
China	[c] 185, 389	150, 000	560, 000	520, 000	480, 000
Chosen	38, 555	83, 273	83, 221	99, 933	99, 795
Czechoslovakia	737, 452	576, 594	334, 837	817, 050	983, 942
Finland	12, 961	7, 080	21, 553	37, 288	[a]
France	3, 344, 414	3, 446, 799	5, 276, 982	5, 431, 787	7, 700, 000
Germany	6, 387, 625	7, 854, 770	[d] 9, 194, 517	[d] 4, 936, 000	[d] 7, 812, 000
Hungary	30, 000	51, 000	117, 000	300, 000	[a]
India	349, 739	404, 673	374, 336	655, 221	923, 125
Italy	108, 953	74, 762	175, 852	269, 166	341, 216
Japan	168, 870	96, 648	77, 265	89, 643	47, 356
Luxemburg	692, 935	970, 336	1, 679, 328	1, 406, 666	2, 157, 170
Mexico	15, 480	41, 540	23, 769	21, 210	[a]
New Zealand	[a]	[a]	82	[a]	630
Norway	5, 771	2, 509	3, 759	26, 395	64, 955
Philippine Islands	87	174	156	269	[a]
Poland	42, 221	60, 443	273, 516	547, 288	335, 850
Rumania [e]	19, 007	33, 362	31, 419	39, 102	46, 081
Russia [f]	103, 688	122, 853	166, 828	155, 000	664, 648
Spain	251, 412	347, 497	209, 792	400, 270	497, 390
Sweden	[g] 488, 437	320, 037	275, 441	301, 619	535, 361
Union of South Africa	1, 368	1, 041			
United Kingdom	8, 163, 674	2, 658, 292	4, 980, 982	7, 559, 920	7, 436, 368
United States	37, 518, 649	16, 955, 970	27, 656, 783	41, 008, 942	31, 909, 853
Yugoslavia	15, 173	11, 881	15, 348	26, 361	15, 019

[a] Data not available.
[b] Official estimate of annual production.
[c] Exports.
[d] Exclusive of the Saar.
[e] Year ended Mar. 31.
[f] Year ended Sept. 30.
[g] Includes sponge iron.

FERRO-ALLOYS

SHIPMENTS, VALUE, AND PRICES

The statistics on the output of ferro-alloys in the United States are separated from those of pig iron in these reports in order to obtain more nearly accurate values for these commodities. Although the quantity of ferro-alloys is small compared with the total shipments of pig iron, the values per ton are so much greater that they would unduly increase the apparent average value of the pig iron if included.

The shipments of ferro-alloys of all classes in 1924, according to reports of all producers, decreased 14 per cent in quantity and 13 per cent in value, as compared with 1923. The ferrovanadium, ferro-

molybdenum, ferromanganese, spiegeleisen, ferrotungsten, and ferrochromium were made in part or wholly from ore imported from Africa, Brazil, Chile, China, Cuba, India, Peru, Porto Rico, and Russia.

A review of the technical developments and market conditions of the ferro-alloy industry by R. J. and L. D. Anderson was published January 1, 1925.[6] According to this article the ferro-alloy trade in 1924 was good but not exceptionally so. The slackening of the steel trade was, of course, responsible for lowered consumption of the major steel-making alloys. Technical research is being continued in the development of processes for making better grades of ferro-alloys and there has been much active interest in the stainless varieties of irons and steels produced through the use particularly of high-chromium alloys. The use of 1.6 to 1.8 per cent manganese steel in locomotive construction is said to be increasing, and the use of vanadium steels for locomotive work also appears promising because of the possibility of thus effecting a saving in weight. The consumption of molybdenum steel is reported too small to warrant much production of molybdenum ore. It has been reported that pure titanium can be produced by a new method, the details of which have not been made public. The world's uranium and radium ore markets are said to be dominated now by the Katanga deposits so that but little carnotite is being mined in the United States.

Tests have apparently demonstrated that titanium and uranium produce certain effects on cast iron that may lead to limited uses for these metals. The results of certain tests with zirconium are considered favorable to the further use of this metal in the steel industry. The use of cobalt and nickel in magnet iron and steel is increasing. The sustained interest in the alloy field is shown by the issuing of many patents for complex and special alloys during 1924.

In 1924 ferromanganese was reported made in 11 localities in the United States, silico-manganese in 1, spiegeleisen in 6, ferrosilicon in 9, ferrophosphorus in 4, ferrochromium in 6, ferromolybdenum in 3, ferrotitanium in 2, ferrotungsten in 7, ferrozirconium in 1, ferrovanadium in 4, and zirconium-ferrosilicon in 1. In many localities, of course, several alloys were made at the same plant. There were 20 plants at which ferro-alloys were manufactured electrically or by a special process not involving a blast furnace.

The following records of average contract prices of ferromanganese and of spiegeleisen, by months for the last four years, show a wide range. The ferromanganese prices are quoted for material "delivered at Pittsburgh"; those of spiegeleisen are prices at producers' furnaces.

[6] Anderson, R. J. and L. D., The ferro-alloy industry in 1924: Iron Age, Jan. 1, 1925, pp. 65–68.

Ferro-alloys shipped from furnaces in the United States, 1923–24

Variety of alloy	1923		1924	
	Gross tons	Value	Gross tons	Value
Ferromanganese	226,365	$23,853,313	[a] 232,821	[a] $23,533,668
Spiegeleisen	134,086	4,547,113	76,179	2,354,731
Ferrosilicon (7 per cent or more silicon)	184,067	9,940,772	150,021	7,558,984
Ferromolybdenum	118	297,842	107	254,970
Ferrotungsten	1,485	2,177,685	741	1,110,553
Ferrovanadium	1,432	3,765,344	1,355	3,641,724
Other varieties [b]	32,264	5,295,162	36,020	4,795,318
	579,817	49,877,231	497,244	43,249,948

[a] Includes a small quantity of silico-manganese.
[b] Ferrocarbide, ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon.

Quoted prices per ton of ferromanganese and spiegeleisen, 1921–1924 [a]

Month	Ferromanganese (delivered at Pittsburgh)				Spiegeleisen (at producer's furnace)			
	1921	1922	1923	1924	1921	1922	1923	1924
January	$101.00	$61.90	$109.79	$113.79	$46.25	$25.50	$34.90	$39.00
February	96.85	65.32	112.29	112.29	37.75	28.00	35.75	39.00
March	89.00	67.82	120.79	112.29	34.20	28.00	37.25	38.00
April	87.50	69.07	124.79	112.29	32.00	30.00	39.25	36.00
May	83.00	72.32	129.79	112.29	31.75	35.00	43.00	36.75
June	76.50	72.82	129.79	112.29	29.60	35.25	46.00	36.00
July	75.00	72.29	122.29	110.79	27.50	35.00	45.00	35.00
August	70.75	72.29	122.29	98.79	26.20	37.00	45.00	32.50
September	64.75	80.59	114.79	97.79	25.25	38.00	43.50	32.00
October	61.65	105.47	112.79	104.79	24.85	37.75	40.00	31.00
November	60.00	104.92	113.79	107.29	25.00	36.80	39.00	31.75
December	60.00	104.92	113.79	109.79	25.00	35.50	38.00	31.00

[a] Iron Trade Review.

IMPORTS AND EXPORTS

The imports of the alloys of the rarer metals are not all reported separately, but are grouped as shown in the next table. Ferromanganese constituted the bulk of the imports, and most of it came from England.

Prior to the new tariff, which went into effect September 22, 1922, the Bureau of Foreign and Domestic Commerce recorded only the gross weight of the ferro-alloy imported. Since that date only the manganese, silicon, etc., contained in certain imports have been recorded. This change should be borne in mind in comparing the quantities in the two following tables with quantities published before the new tariff became effective. The values, however, are comparable.

The exports of ferro-alloys are relatively unimportant. In 1924, according to available statistics, they decreased 23 per cent in quantity and 14 per cent in value. Ferromanganese constituted the greater part of the exports.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1923–24

Variety of alloy	1923		1924	
	Gross tons	Value	Gross tons	Value
Ferromanganese (manganese content)	91,066	$8,357,023	45,270	$3,844,474
Spiegeleisen	4,668	165,791	7,433	235,566
Chrome or chromium and ferrochromium	1,481	281,279	468	123,786
Ferrosilicon (silicon content)	11,544	1,044,221	12,125	1,249,071
Molybdenum and ferromolybdenum (molybdenum content)	[a]	5	[b]	802
Titanium and ferrotitanium	6	2,949	13	5,927
Tungsten and ferrotungsten (tungsten content)	35	28,165	63	49,394
		9,879,433		5,509,020

[a] 4 pounds. [b] 431 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1923–24, by countries

[General imports]

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1923		1924		1923		1924	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Belgium					86	$12,136		
Canada	52	$1,503	216	$29,478	9,557	841,144	9,779	$1,030,957
Chile							12	5,371
China							50	6,856
England	88,229	8,564,813	36,856	3,302,206	41	1,731		
France	86	13,925	166	30,894	77	8,537	13	1,594
Germany	199	24,025	114	16,297	91	10,959	3	418
India (British)			103	7,006				
Netherlands			79	6,445				
Norway			10,277	662,365	1,115	106,398	1,624	144,121
Sweden	4	1,042			768	73,420	487	42,222
Switzerland							23	3,072
	88,570	8,605,308	47,811	4,054,691	11,735	1,054,325	11,991	1,234,611

Ferro-alloys and ferro-alloy metals exported from the United States, 1922–1924

Variety of alloy	1922		1923		1924	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Ferromanganese	1,107	$76,822	[a] 4,295	[a] $151,224	[a] 3,165	[a] $92,421
Spiegeleisen	289	7,740				
Ferrochrome and chrome metal	23	1,941	[a]	[a]	[a]	[a]
Ferrosilicon	689	30,939	814	31,154	775	29,214
Tungsten and ferrotungsten	[b]	43,219	[c] 2	[c] 122,906	[c] 2	[c] 114,775
Ferrovanadium	22	69,279	23	64,713	25	81,016

[a] Not separately classified. [b] 1,009 pounds. [c] Includes tungsten wire.

STEEL

PRODUCTION

The following tables showing the production of steel were compiled by the American Iron and Steel Institute. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of the Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of Bessemer steel billets at Pittsburgh in 1924 ranged from $35.50 to $40 a gross ton; in 1923 it ranged from $37.30 to $45. Tank plates at Pittsburgh ranged from 1.8 to 2.5 cents a pound in 1924 and from 2.06 to 2.5 cents a pound in 1923. Steel beams at Pittsburgh ranged from 1.93 to 2.5 cents a pound in 1924 and from 2.06 to 2.5 cents in 1923.

Bessemer steel ingots and castings manufactured in the United States, 1920–1924, in gross tons

State	1920	1921	1922	1923	1924
Ohio	3,662,718	1,581,610	2,324,425	3,557,579	2,557,689
Pennsylvania	3,279,023	1,665,456	2,474,956	3,115,840	2,210,868
Illinois	1,243,837	532,539	707,067	1,057,576	598,442
Other States	697,509	236,333	412,850	753,093	532,591
	8,883,087	4,015,938	5,919,298	8,484,088	5,899,590

Open-hearth steel ingots and castings manufactured in the United States, 1920–1924, in gross tons

State	1920	1921	1922	1923	1924
New England States	290,967	102,642	204,343	268,630	252,273
New York and New Jersey	2,010,895	634,290	1,597,881	1,951,278	1,424,677
Pennsylvania	14,184,477	6,408,043	11,583,812	14,428,187	12,243,713
Ohio	6,341,016	3,108,332	6,770,293	7,786,820	7,119,786
Indiana	3,785,056	2,308,414	3,571,397	4,326,724	3,990,165
Illinois	2,302,776	1,093,268	2,077,920	2,579,095	2,184,068
Other States	3,756,708	1,934,813	3,503,337	4,558,923	4,362,668
	32,671,895	15,589,802	29,308,983	35,899,657	31,577,350

According to these tables there were decreases of 30 per cent in the production of Bessemer steel and of 12 per cent in open-hearth steel in 1924, compared with 1923. In the total production of steel there was a decrease of 16 per cent. Of the total output in 1924, 83 per cent was represented by open-hearth steel, 16 per cent by Bessemer steel, and a little more than 1 per cent by all other classes of steel.

Of the total output of open-hearth steel, 30,719,523 gross tons were made by the basic process and 857,827 tons by the acid process, compared with 34,665,021 tons of basic steel and 1,234,636 tons of acid steel in 1923.

The production of steel by the electric process in 1924 showed a decrease of 16 per cent as compared with 1923.

Steel electrically manufactured in the United States, 1909–1924, in gross tons

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1909	13,456	306	13,762	1917	239,632	64,911	304,543
1910	50,821	1,320	52,141	1918	403,068	108,296	511,364
1911	27,227	1,878	29,105	1919	272,942	111,510	384,452
1912	14,147	4,162	18,309	1920	346,956	155,196	502,152
1913	20,973	9,207	30,180	1921	84,404	85,095	169,499
1914	15,458	8,551	24,009	1922	191,057	154,982	346,039
1915	46,348	23,064	69,412	1923	279,914	235,958	515,872
1916	126,048	42,870	168,918	1924	225,977	206,549	432,526

In the total production of electric steel in 1924 are included 188,563 tons of alloy-steel ingots and castings which were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals (159,742 tons of ingots and 28,821 tons of castings), compared with 194,976 tons (165,922 tons of ingots and 29,054 tons of castings) so alloyed in 1923.

On December 31, 1924, the number of completed plants equipped for the manufacture of steel by the electric process was 206, as compared with 203 plants at the end of both 1923 and 1922.

Steel produced in the United States, 1810–1924, in gross tons

Year	Bessemer	Open-hearth	Crucible	Other steel	Total
1810–1870	58,482	2,232	146,370		207,084
1871	40,179	1,785	31,250		73,214
1872–1880	4,293,896	245,035	349,730	76,009	4,964,670
1881–1890	21,596,699	2,387,925	703,489	37,044	24,725,157
1891–1900	49,387,341	15,392,764	762,446	35,820	65,578,371
1901–1910	94,048,698	92,418,814	1,051,379	154,683	187,673,574
1911–1915	42,329,520	98,833,090	544,047	185,392	141,892,349
1916	11,059,039	31,415,427	129,692	169,522	42,773,680
1917	10,479,960	34,148,893	126,716	305,038	45,060,607
1918	9,376,236	34,459,391	115,112	511,693	44,462,432
1919	7,271,562	26,948,694	63,572	387,404	34,671,232
1920	8,883,087	32,671,895	72,265	505,687	42,132,934
1921	4,015,938	15,589,802	7,613	170,444	19,783,797
1922	5,919,298	29,308,983	28,606	346,039	35,602,926
1923	8,484,088	35,899,657	44,079	515,872	44,943,696
1924	5,899,590	31,577,350	22,473	432,526	37,931,939

FOREIGN TRADE IN STEEL

Iron and steel imported into the United States, 1922–1924

Article	1922		1923		1924	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Bar iron	8,092	$516,380	7,754	$451,508	4,325	$262,164
Boiler and other plate of iron and steel	[a] 1,141	[a] 42,003	1,818	91,478	3,276	125,705
Iron and steel scrap	142,969	1,841,375	162,068	2,783,406	66,841	1,026,277
Rails for railways	26,629	886,569	29,706	963,142	43,358	1,313,041
Sheets of iron or steel, skelps, saw plates and steel	[a] 380	[a] 52,470	2,754	316,538	2,789	200,235
Sheets and plates	[b] 426	[b] 94,048	(c)	(c)	(c)	(c)
Steel ingots, bars, etc	27,720	2,597,382	22,671	2,371,886	39,024	3,074,303
Tin and terne plates	2,682	309,255	10,037	1,166,790	1,036	157,659
Wire and articles made from wire		1,467,556		3,562,923		6,130,604
Wire rods	1,735	150,980	3,948	312,899	6,851	460,367
All other manufactures—free		[b] 364,773				
All other manufactures—dutiable		7,135,199		2,813,579		2,264,462
		15,457,990		14,834,149		15,014,817

[a] Sept. 22 to Dec. 31. [b] Jan. 1 to Sept. 21. [c] Classification discontinued with new tariff, Sept. 22, 1922.

According to available records, the value of the steel and iron imported in 1924 showed an increase of 1 per cent as compared with that of 1923; the exports of steel and iron decreased 8 per cent in quantity and 10 per cent in total value.

Iron and steel exported from the United States, 1922–1924

Article	1922		1923		1924	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Axes		$692, 136		$1, 174, 897		$1, 569, 024
Bars or rods (of steel):						
Wire	40, 424	1, 819, 504	40, 868	2, 163, 436	18, 762	1, 048, 174
All other	13, 897	1, 487, 031	115, 845	11, 512, 552	102, 276	7, 804, 417
Billets, ingots, blooms, sheet, bar, and skelp	107, 334	3, 986, 004	111, 233	5, 868, 048	96, 096	4, 656, 225
Bolts and nuts	18, 325	3, 035, 426	18, 907	3, 823, 324	17, 495	2, 930, 966
Hammers and hatchets		247, 971		396, 925		348, 867
Hoops and bands	34, 512	2, 742, 947	38, 244	4, 401, 997	34, 141	2, 942, 593
Horseshoes	987	164, 461	951	149, 251	963	121, 528
Horseshoe nails	795	241, 279	1, 113	305, 553	1, 025	275, 986
Iron and steel bars, not containing alloys	171, 356	8, 960, 726	[a] 12, 662	[a] 1, 075, 518	[a] 5, 054	[a] 514, 311
Iron and steel scrap	64, 784	996, 507	65, 980	1, 035, 637	97, 748	1, 531, 361
Nails:						
Cut nails	3, 509	283, 360	2, 300	202, 906	2, 122	195, 547
Wire nails	55, 022	4, 127, 136	45, 981	4, 103, 330	21, 665	1, 934, 081
All other, including tacks	4, 053	1, 064, 137	5, 346	1, 436, 978	4, 739	1, 133, 523
Radiators and cast-iron house-heating boilers	5, 413	911, 499	5, 963	1, 090, 128	3, 875	782, 044
Rails for railways, of steel	277, 090	10, 833, 210	267, 409	10, 273, 970	208, 829	7, 954, 256
Railroad spikes	7, 895	530, 754	8, 597	686, 331	7, 986	577, 976
Railroad-track material, switches, frogs, fishplates, splices, bars, etc.	30, 402	2, 868, 524	30, 991	3, 097, 253	25, 885	2, 637, 730
Saws		606, 171		2, 003, 535	1, 589	2, 497, 832
Sheets and plates:						
Galvanized	109, 320	10, 191, 841	114, 749	12, 395, 505	108, 152	11, 940, 379
Iron	15, 389	689, 062	16, 016	1, 089, 565	10, 955	583, 339
Shovels and spades		393, 133		533, 517		506, 555
Steel:						
Plates, not fabricated	88, 617	3, 906, 073	102, 375	6, 672, 012	81, 686	5, 042, 169
Sheets, black	214, 911	15, 899, 934	139, 105	13, 514, 749	148, 742	13, 302, 370
Structural iron and steel	167, 585	9, 672, 927	198, 991	13, 584, 040	167, 910	13, 009, 647
Tin and terne plates	76, 633	7, 950, 473	124, 499	14, 791, 961	160, 997	19, 430, 327
Tubular products and fittings:						
Boiler tubes	12, 073	1, 552, 354	16, 518	2, 397, 182	12, 363	1, 732, 237
Casings and oil-line pipes	51, 726	4, 517, 507	64, 118	7, 041, 769	87, 383	8, 977, 576
Welded black pipes	75, 073	6, 040, 936	76, 591	7, 398, 704	64, 964	6, 411, 242
Welded galvanized pipes	32, 519	3, 228, 290	28, 681	3, 351, 836	36, 241	3, 847, 972
Malleable-iron pipe fittings	7, 848	1, 839, 274	7, 747	2, 400, 367	[b]	[b]
Malleable-iron screwed pipe fittings	[b]	[b]	[b]	[b]	11, 024	2, 855, 563
Cast-iron pipe	18, 001	1, 340, 693	15, 308	1, 538, 500	[b]	[b]
Cast-iron pipe fittings	9, 301	2, 010, 651	12, 757	3, 193, 877	[b]	[b]
Cast-iron pressure-pipe fittings	[b]	[b]	[b]	[b]	13, 364	2, 527, 809
Cast-iron soil pipes and fittings	[b]	[b]	[b]	[b]	7, 432	597, 034
Cast-iron screwed pipe fittings	[b]	[b]	[b]	[b]	7, 975	1, 352, 592
Wire:						
Barbed	70, 828	5, 475, 578	70, 803	6, 173, 678	87, 033	6. 524, 302
All other	138, 839	13, 033, 702	103, 985	14, 437, 465	58, 479	8, 277, 471
All other tools		9, 773, 831		11, 600, 979		10, 665, 572
		143, 115, 042		176, 917, 275		159, 040, 597

[a] Iron bars only.

[b] Not so classified.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By C. N. Gerry

PRODUCTION

GENERAL FEATURES

The value of the mine production of gold, silver, copper, lead, and zinc in Montana in 1924 was 5 per cent less than that in 1923. Although the quantity of copper and the quantity and value of gold and lead increased, there was a decrease in the value of copper and in the quantity and value of silver and zinc. Silver Bow County, which includes the Butte or Summit Valley district, continued to produce most of the silver, copper, lead, and zinc; most of the gold was produced in other counties, though Silver Bow County produced more gold than any other county. Published reports show that the Anaconda Copper Mining Co. and the Butte Copper & Zinc Co. paid dividends amounting to $2,550,000. This amount does not include the distribution of funds from the sale of the Davis Daly property. Although a complete record of Montana dividends has never been kept, one of the mining journals [1] estimates that to and including 1924 mining companies in this State have paid dividends amounting to $334,442,368. The Anaconda, Amalgamated, North Butte, Butte & Superior, and Parrott companies paid the larger part of this total.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1924

	Number of producers	Ore, tailings, and slag	Gold *	Silver *	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	388	4, 652, 482	$2, 022, 825	13, 289, 303	249, 152, 062	39, 476, 008	128, 475, 218	$55, 074, 548
Increase or decrease from 1923	+6	−1, 091, 053	+264, 077	−91, 559	+25, 026, 798	+3, 530, 385	−12, 985, 174	−2, 738, 422

* Includes placer production.

The production of Montana from 1911 to 1922, by kinds of ore, is given in tables published in Mineral Resources for 1922. Al-

[1] Mining Truth, May 16, 1925, p. 10.

though silver shows no decrease in output since 1911, gold has decreased 45 per cent. The largest yield of gold was from dry and siliceous ore, and most of the remainder from placers and copper ore. The largest yield of silver was from copper ore and from zinc, lead-zinc, and siliceous ores. The output of lead from lead ore was relatively small; most of it came from zinc ore and lead-zinc ore combined.

ORE

The quantity of ore, old tailings, and slag sold or treated in Montana in 1924 was 19 per cent less than that of 1923, but the average value in metals increased from $10.06 a ton to $11.83. Of the total ore, etc., 90 per cent was concentrated, 2 per cent was treated in gold and silver mills, and 3 per cent was shipped directly to smelters. The remaining 5 per cent consisted of slag, which was resmelted, and old tailings, which were smelted, concentrated, or cyanided.

Mines in Silver Bow County produced 90 per cent of the total ore mined. The dry and siliceous ore was mainly gold ore and silver ore. The gold ore included much gold-bearing iron ore from Deer Lodge and Broadwater Counties, which was used at the smelters for fluxing. Copper ore represented 74 per cent of the total output of ore and lead-zinc ore 15 per cent. The quantities of different kinds of first-class shipping ore and concentrates, with their recoverable contents, are given in the tables on pages 344–345. Copper ore and copper concentrates exceeded all other kinds. Most of the first-class ore was sulphide.

Ore and metals produced in Montana in 1924

Source	Number of producers	Ore, tailings, and slag		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore and tailings	110	154,942	3.33	57,701.18	58.97	254,478	1.92
Dry gold and silver ore and tailings	7	161	----------	133.32	.13	4,260	.03
Dry silver ore, tailings, and slag	65	52,384	1.13	5,339.76	5.46	688,345	5.18
Copper ore, tailings, and slag	26	3,437,931	73.89	24,926.12	25.47	7,845,180	59.03
Lead ore and slag	86	78,656	1.69	1,486.37	1.52	287,041	2.16
Copper-lead ore	2	160,883	3.46	332.74	.34	573,038	4.31
Lead-zinc ore	20	719,223	15.46	6,123.90	6.26	3,211,443	24.17
Copper-lead-zinc ore	1	48,302	1.04	487.18	.50	425.331	3.20
Total deep mines	-------	4,652,482	100.00	96,530.57	98.65	13,289,116	100.00
Total placers	86	----------	----------	1,323.59	1.35	187	----------
	-------	4,652,482	100.00	97,854.16	100.00	13,289,303	100.00

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore and tailings	288,070	0.12	223,596	0.57	----------	----------
Dry gold and silver ore and tailings	----------	----------	1,325	----------	----------	----------
Dry silver ore, tailings, and slag	20,945	.01	402,094	1.02	----------	----------
Copper ore, tailings, and slag	243,927,687	97.90	----------	----------	----------	----------
Lead ore and slag	222,066	.09	7,829,188	19.83	----------	----------
Copper-lead ore	1,181,998	.47	2,339,877	5.93	----------	----------
Lead-zinc ore	2,474,284	.99	27,459,296	69.56	119,581,078	93.08
Copper-lead-zinc ore	1,037,012	.42	1,220,632	3.09	8,894,140	6.92
	249,152,062	100.00	39,476,008	100.00	128,475,218	100.00

GOLD ORE

Gold ore, largely dry and siliceous, was mined by 110 producers in 1924, compared with 78 in 1923. This ore and tailings averaged $7.70 in gold and 1.64 ounces of silver to the ton, contained a little copper and lead, and was valued at $9.16 a ton in metals. Jefferson, Park, Lewis and Clark, Phillips, Deer Lodge, and Broadwater Counties, in the order named, produced most of the gold ore, and the Jib mine, at Basin, was the largest producer.

Dry gold ore and tailings sold or treated in Montana in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	10	86.53	9		
Broadwater	3,619	808.22	259	2,999	7,398
Deer Lodge	3,717	2,454.21	155	106	
Fergus	68	57.70	32		
Granite	646	790.16	864	599	
Jefferson	68,838	33,029.50	182,811	282,635	199,312
Lewis and Clark	22,599	6,798.74	20,772		86
Madison	2,053	1,082.12	2,228	1,731	142
Meagher	9	8.40	3		
Mineral	105	56.69	36		
Park	49,214	10,043.73	1,359		
Phillips	3,946	2,356.75	45,373		11,387
Powell	72	50.16	388		4,919
Ravalli	8	6.80	1		
Silver Bow	38	71.47	188		352
	154,942	57,701.18	254,478	288,070	223,596

GOLD AND SILVER ORE

Gold and silver ore, with one lot of tailings, was mined in two counties by seven producers, who reported an output that averaged $17.12 in gold and 26.46 ounces of silver to the ton and 0.41 per cent of lead. The U. S. Grant mine, in Alder Gulch district, Madison County, produced several lots of ore in which the value of the gold was nearly equal to that of the silver.

SILVER ORE

A total of 65 producers reported the output of siliceous silver ore, tailings, and slag which averaged $2.11 in gold and 13.14 ounces of silver to the ton, 0.02 per cent of copper, and 0.38 per cent of lead. A marked decrease was shown in this class of ore, especially from the mines at Butte. Some of the large producers of silver ore or tailings were the Elkhorn dump, in Jefferson County, the Champion mine, in Deer Lodge County, and the Minnie Jane and Goldsmith properties, at Butte, in Silver Bow County.

Dry silver ore, tailings, and slag sold or treated in Montana in 1924, with content in terms of recovered metals

County	Ore, tailings, and slag	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	84	2.98	9,006	529	
Broadwater	3,785	.30	6,624	211	235,511
Cascade	1,922	420.57	48,986	5,181	73,521
Deer Lodge	8,873	231.08	77,459	67	
Fergus	34	6.60	1,182		
Granite	1,290	220.59	47,723	743	
Jefferson	21,111	152.44	60,107	7,488	54,477
Lewis and Clark	367	25.60	7,613	61	26,912
Madison	184	14.96	1,796	457	6,916
Powell	57	67.44	3,320	359	4,757
Silver Bow	14,677	4,197.20	424,529	5,849	
	52,384	5,339.76	688,345	20,945	402,094

COPPER ORE

Copper ore (including tailings and slag) decreased 22 per cent in quantity; the output, reported by 26 producers, represented 74 per cent of the total output. The average recoverable content which showed a marked increase was 15 cents in gold, 2.28 ounces of silver, and 3.55 per cent of copper, or 70.95 pounds to the ton; the average value per ton in metals was $10.97. Nearly all the copper ore was mined at Butte, largely from the Anaconda, Butte & Superior, East Butte, Davis Daly, Anselmo, and North Butte properties, and most of it was milling ore.

Copper ore, tailings, and slag sold or treated in Montana in 1924, with content in terms of recovered metals

County	Ore, tailings, and slag	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Beaverhead	4	0.05	94	2,026
Granite	168	2.27	1,405	30,833
Jefferson	50	7.77	360	13,318
Lewis and Clark	56	.13	173	23,865
Madison	32	110.92	272	1,739
Silver Bow	3,437,621	24,804.98	7,842,876	243,855,906
	3,437,931	24,926.12	7,845,180	243,927,687

LEAD ORE

The output of lead ore and slag by 86 producers carried metals valued at $878,469, or an average of $11.17 a ton. The average content was 39 cents in gold and 3.65 ounces of silver to the ton, 0.14 per cent of copper, and 4.98 per cent of lead. Beaverhead, Judith Basin, Lincoln, Lewis and Clark, and Jefferson Counties yielded most of the lead ore, and the Hecla slag dump, Block P., Lukens Hazel, Mike Horse, and Baltimore mines were large producers.

Lead ore and slag sold or treated in Montana in 1924, with content in terms of recovered metals

County	Ore and slag	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	36,618	29.63	58,581	177,917	3,479,057
Broadwater	722	43.90	15,234	832	309,958
Cascade	736	33.20	25,352	10,028	119,122
Fergus	2	1.40	13		1,192
Granite	39	31.00	303	14	14,555
Jefferson	1,465	153.20	30,055	14,391	245,127
Judith Basin	26,354	296.49	115,505	4,304	2,544,123
Lewis and Clark	2,577	108.43	16,972	7,287	485,653
Lincoln	8,060	262.60	10,075		138,587
Madison	783	371.52	6,491	5,224	260,152
Meagher	1,064	.40	920	1,235	129,622
Mineral	12		311		4,000
Park	32	.30	959		8,368
Powell	159	154.30	5,117		63,118
Sanders	33		1,153	834	26,554
	78,656	1,486.37	287,041	222,066	7,829,188

COPPER-LEAD ORE AND COPPER-LEAD-ZINC ORE

The output of copper-lead ore was reported by two producers. The average content was 4 cents in gold and 3.56 ounces of silver to the ton, 0.37 per cent of copper, and 0.73 per cent of lead; the average value in metals was $4.56 a ton. Nearly all the output was mill ore from the Silver Dyke property, in Cascade County.

Copper-lead-zinc ore was mined by one producer. The ore contained an average of 21 cents in gold and 8.81 ounces of silver to the ton, 1.07 per cent of copper, 1.26 per cent of lead, and 9.21 per cent of zinc, and the average value in metals was $22.91 a ton.

LEAD-ZINC ORE

Lead-zinc ore represented 15 per cent of the total output and was mined by 20 producers; it averaged 18 cents in gold and 4.47 ounces of silver to the ton, 0.17 per cent of copper, 1.91 per cent of lead, and 8.31 per cent of zinc. The total average value in metals was $17.48 a ton. Eleven mines at Butte produced most of the lead-zinc ore; all of it was milled at Butte or Anaconda. The Butte & Superior mine, at Butte, was the largest producer.

No zinc ore was mined in 1924; that is, all the zinciferous ore contained enough lead to make a lead-zinc concentrate.

Lead-zinc ore sold or treated in Montana in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	40		300		10,500	12,240
Cascade	29	1.00	290	42	4,575	8,264
Jefferson	2,227	213.70	18,574	7,677	307,782	374,027
Lincoln	25,194	88.90	25,835	377	1,060,134	244,800
Silver Bow	691,733	5,820.30	3,166,444	2,466,188	26,076,305	118,941,747
	719,223	6,123.90	3,211,443	2,474,284	27,459,296	119,581,078

The following table gives the zinc product made from 1921 to 1924; also the average zinc content (assay) and recovered zinc:

Lead-zinc ore and concentrates (as marketed from Montana mines and mills) sold to smelters, 1921–1924

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrate	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
1921					
Lead-zinc concentrates	Granite, Lincoln, Silver Bow	31,186	27,024,577	43.33	23,275,966
1922					
Zinc and lead-zinc concentrates	Granite, Jefferson, Silver Bow	149,376	142,280,776	47.63	119,069,818
1923					
Sulphide lead-zinc ore	Missoula	34	14,866	21.86	11,893
Zinc and lead-zinc concentrates	Broadwater, Cascade, Granite, Jefferson, Lincoln, Silver Bow	177,416	167,450,573	47.19	141,448,499
		177,450	167,465,439	47.19	141,460,392
1924					
Zinc, lead-zinc, and copper-lead-zinc concentrates.	Broadwater, Cascade, Jefferson, Lincoln, Silver Bow	164,706	161,153,439	48.92	128,475,218

GOLD

Although the output of gold in Montana in 1924 was 15 per cent larger than that of 1923, it was considerably less than that of a normal year. The output decreased from $5,004,195 in 1915 to $2,022,825 in 1924. Silver Bow County reported the largest output, owing to the general activity at Butte; Jefferson County was a close second. Park, Lewis and Clark, Deer Lodge, Phillips, and Madison Counties were the next largest producers. Since dredging at Alder Gulch, Madison County, ceased, placer mines show a marked decrease in output. Work at the Jib mine, near Basin, caused the great increase in output of gold from Jefferson County. Mines at Butte produced more gold, though less ore was treated. Twelve per cent of the gold was produced at amalgamation and cyanidation mills, which yielded an average recovery of $2.48 in gold and 71 cents in silver to the ton of ore and tailings treated. Concentrates of all kinds contained about 73 per cent of the gold and crude ore shipped to smelters 13 per cent of the total. Dry and siliceous ore yielded nearly 65 per cent of the gold, copper ore 25 per cent, lead-zinc ore 6 per cent, lead ore 2 per cent, placers 1 per cent, and copper-lead-zinc and copper-lead ore 1 per cent. All these sources showed increases except placers and lead ore.

Six properties produced nearly 77 per cent of the total quantity of gold. The Jib mine, at Basin, Jefferson County, ranked first, followed by the copper mines of the Anaconda Copper Mining Co., at Butte; the Jardine mine, in the Sheepeater district, Park County;

the Drumlummon mine, near Marysville, Lewis and Clark County; the August mine, near Landusky, Phillips County; and the Goldsmith mine, at Butte.

SILVER

The output of silver from mines in Montana in 1924 was 1 per cent less than in 1923, but exceeded the yearly average, 13,161,600 ounces, of the decade 1915–1924. Fifty-nine per cent of the silver was obtained from copper ore and 24 per cent from lead-zinc ore. Silver Bow County, chiefly the Butte district, produced 89 per cent of the total. Cyanidation and amalgamation mills produced 1 per cent of the silver, concentrates 91 per cent, crude ore shipped to smelters 7 per cent, and old slag and tailings smelted 1 per cent.

Eight properties produced 85 per cent of the silver; each of these produced more than 200,000 ounces, and two of them, the copper mines of the Anaconda Co. and the Butte & Superior mine, more than 2,000,000 ounces each. Other large producers were the Elm Orlu, the zinc mines of the Anaconda Co., the Silver Dyke, Anselmo, Emma & Ophir, and old tailings dump of the Anaconda Co.

COPPER

The mine production of copper in 1924 was 11 per cent greater in quantity than in 1923 and considerably more than any year since 1918. In that year the mines of Montana produced 323,174,850 pounds of copper. Most of the large mines of Butte were active, but the margin of profit was too small to be an incentive for a record output.

The total output of copper, except for 1,787,107 pounds, came from Silver Bow County, which includes the Butte district. Copper ore yielded 98 per cent of the copper. Crude ore of all kinds shipped to smelters contained 4 per cent of the copper, and concentrates 94 per cent. The sulphide copper ore of smelting grade contained 10,006,312 pounds, an average content of 4.13 per cent, and the oxidized ore 54,323 pounds, an average content of 12.02 per cent. Slag resmelted, old tailings, and the copper precipitates from mine waters contained 5,262,503 pounds.

Five properties in Montana each produced more than 1,000,000 pounds of copper in 1924. The mines of the Anaconda Copper Mining Co. yielded more than all others combined. The Butte & Superior, East Butte, Anselmo, and Silver Dyke mines were large producers, followed by the Davis Daly, Elm Orlu, and North Butte mines. Considerable copper was produced from old tailings resmelted at Anaconda.

LEAD

The mine production of lead in Montana increased 10 per cent in quantity over that of 1923. Sixty-nine per cent of the output was derived from mines in Silver Bow County. Lead-zinc ore yielded nearly 70 per cent of the lead, lead ore and slag 20 per cent, copper-lead ore 6 per cent, copper-lead-zinc ore 3 per cent, and dry and siliceous ore nearly 2 per cent. Crude ore of all kinds shipped to

the smelters contained 4 per cent of the total lead, concentrates 86 per cent, and old slag 10 per cent. Most of the first-class lead ore was sulphide.

Ten properties—the Butte & Superior, Emma & Ophir, Elm Orlu, zinc mines of the Anaconda Co., Hecla slag dump, Block P, Silver Dyke, Moulton, Anselmo, and Poser mines, each yielding more than 1,000,000 pounds—produced nearly all of the total output of lead.

ZINC

The mine production of zinc in Montana in 1924 was 9 per cent less than in 1923. At Great Falls the electrolytic zinc plant of the Anaconda Co. was enlarged and ran continuously. A large part of the material treated was custom concentrate from various western States and from Canada. No lead-zinc concentrate from Butte was shipped to eastern smelters. The Butte & Superior Mining Co., the largest producer of zinc, was active throughout the year. The output of this mine, as well as that of the Elm Orlu, was much less than in 1923. Lead-zinc ore yielded 93 per cent of the zinc and copper-lead-zinc ore 7 per cent.

Eight properties at Butte—the Butte & Superior, Elm Orlu, Emma & Ophir, Anaconda (zinc), Anselmo, Poser, Moulton, and Davis Daly—produced nearly all the zinc.

MINING INDUSTRY

Copper mining in Montana was unusually free from labor troubles and disturbances that interrupt regular output. Although the production and consumption of copper in 1924 were fairly well balanced, the price of the metal was comparatively low, and several Montana companies found 13.10 cents a pound was dangerously close to the cost of production. Consequently it is not surprising, in what is primarily a copper-producing State, that the total output of metals showed no marked improvement, though there were increases in the output of gold, copper, and lead. The companies at Butte made no effort to exceed a production of about 20,000,000 pounds of copper a month, but they were unusually active in prospecting and development work. Under the prevailing conditions the North Butte Co. was not able to mine profitably on company account, and the East Butte smelter, the only one at Butte, was forced to close indefinitely in August. Though the production of zinc from mines in Montana decreased 9 per cent, the zinc plant at Great Falls was enlarged; with the increasing demand for zinc there was good reason to believe that more custom ore would be treated in 1925. The production of silver, which has kept pace with that of copper, exceeded 13,000,000 ounces both in 1923 and 1924. The output of gold had been gradually decreasing from 1915 to 1921, but in 1924 increased to more than $2,000,000. The Shannon mine, at Marysville, was exhausted, but other mines at Zortman, Marysville, and Jardine made up for this deficiency.

METALLURGIC INDUSTRY

Thirty-seven milling plants of various kinds were active in Montana in 1924, though many of them ran for short periods only. They included 10 plants using the amalgamation process, 3 using amalgamation and concentration, 7 using cyanidation, 2 using amalgamation, concentration, and cyanidation, 3 using table concentration, 8 using flotation equipment after table concentration, and 1 using straight flotation. Two copper-precipitating plants that recover copper from mine waters and one electrolytic zinc-leaching plant are included in the total.

Of the ore and old tailings treated at gold and silver mills 58,474 tons of ore were treated by amalgamation, with an average recovery per ton of $1.82 in gold and 0.02 ounce of silver, and 18,771 tons of ore and 21,005 tons of old tailings were treated by cyanidation, with an average recovery per ton of $3.46 in gold and 2.59 ounces of silver. During the year 97 pounds of quicksilver were purchased—0.0017 pound per ton of ore amalgamated and 0.015 pound per ounce of gold and silver bullion recovered—and 84,770 pounds of sodium cyanide were used in gold and silver mills—0.77 pound per ounce of gold and silver bullion and 2.13 pounds per ton of ore and tailings treated. The amount of ore treated by these processes in 1924 decreased 60 per cent, partly because of the closing of the Shannon mine at Marysville. The quantity of gold recovered by cyanidation decreased 79 per cent and that recovered by amalgamation 26 per cent.

Gold and silver produced at mills in Montana in 1924

County	Ore (short tons)	Bullion (fine ounces) recovered by—				Total value
		Amalgamation		Cyanidation		
		Gold	Silver	Gold	Silver	
Beaverhead	3	4.04	1			$84
Broadwater	7	132.52	24			2,755
Fergus	68			57.70	32	1,215
Granite	[a] 583	167.97	16	27.18	13	4,053
Jefferson	532	25.36	11	[b] 252.90	[b] 54,021	41,953
Lewis and Clark	20,974	626.13	406	[c] 4,892.18	[c] 15,009	124,402
Madison	[d] 1,798	464.74	253	88.11	454	11,902
Meagher	9	8.40	3			176
Mineral	105	56.69	36			1,196
Park	[e] 49,214	3,647.60	521			75,752
Phillips	[f] 3,946			1,333.75	33,383	49,937
Ravalli	6	4.29				89
	77,245	5,137.74	1,271	6,651.82	102,912	313,514

[a] Also yielded 84 tons of siliceous concentrate.
[b] Includes bullion from 20,000 tons of old tailings.
[c] Includes bullion from 1,005 tons of old tailings.
[d] Also yielded 34 tons of siliceous concentrate and 1 ton of lead concentrate.
[e] Also yielded 4,152 tons of siliceous concentrate.
[f] Also yielded 238 tons of siliceous concentrate.

Concentrating mills in Montana treated 90 per cent of the total material treated. The resulting concentrates averaged $32.83 in metals a ton, and the quantity of concentrates produced was 4 per cent greater than in 1923. The increase was especially marked in copper concentrate and lead-zinc concentrate.

Mine production of metals from Montana concentrates in 1924

By counties

County	Ore to concentrating mills	Concentrates	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Broadwater	3,540	883	578.00	300	1,976	10,500	12,240	$14,043
Cascade	160,786	8,824	318.68	563,478	1,171,485	2,289,108	8,264	721,249
Deer Lodge	8,856	145	229.51	77,083				56,390
Granite		84	373.35	583	599			8,187
Jefferson	70,070	10,696	32,120.30	198,343	288,379	505,057	374,027	899,370
Judith Basin	25,853	5,468	276.19	100,173	2,657	2,199,174		249,107
Lewis and Clark	2,210	442	4.40	8,157	6,667	343,348		33,897
Lincoln	33,254	1,885	351.50	35,910	377	1,198,721	244,800	143,185
Madison		35	79.79	241	216	142		1,850
Park		4,152	6,396.13	838				132,781
Phillips		238	1,023.00	11,990		11,387		30,091
Silver Bow	3,897,384	1,529,696	29,963.94	11,141,563	232,295,555	27,296,937	127,835,887	49,008,063
	4,201,953	1,562,548	71,714.79	12,138,659	233,767,911	33,854,374	128,475,218	51,298,213

By kinds of concentrates

Dry and siliceous	15,533	40,583.28	270,454	283,493	208,662		$1,073,966
Copper	1,363,010	23,718.68	7,600,561	229,046,713			35,587,804
Lead	11,816	1,062.39	331,148	70,541	6,803,907		797,385
Zinc	40,859	1,017.00	597,602	709,054	2,571,772	38,106,971	3,196,998
Copper-lead	7,483	255.44	512,415	917,085	2,284,533		651,499
Lead-zinc	112,938	4,590.80	2,401,148	1,704,013	20,764,868	81,474,107	8,883,901
Copper-lead-zinc	10,909	487.20	425,331	1,037,012	1,220,632	8,894,140	1,106,660

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Dry and siliceous	15,533	2.613	17.41	0.91	0.67		$69.14
Copper	1,363,010	.017	5.58	8.40			26.11
Lead	11,816	.090	28.03	.30	28.79		67.48
Zinc	40,859	.025	14.63	.87	3.15	46.63	78.24
Copper-lead	7,483	.034	68.48	6.13	15.26		87.06
Lead-zinc	112,938	.040	21.26	.75	9.19	36.07	78.66
Copper-lead-zinc	10,909	.045	38.99	4.75	5.59	40.77	101.44
	1,562,548	.046	7.77	7.48	1.08	4.11	32.83

Crude ore directly smelted in 1924 averaged $15.82 in metals a ton. A decrease of 17 per cent in quantity was recorded, especially in copper ore and siliceous ore.

Mine production of metals from Montana crude ore shipped to smelters in 1924

By counties

County	Ore	Gold	Silver	Copper	Lead	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Beaverhead	346	120.03	19,968	13,627	103,300	$25,909
Broadwater	834	141.60	15,469	1,855	317,356	38,923
Cascade	1,131	453.77	69,993	10,431	119,122	67,171
Deer Lodge	3,734	2,455.78	531	173	----------	51,145
Fergus	36	8.00	1,195	----------	1,192	1,061
Granite	1,560	475.52	49,683	31,590	14,555	48,420
Jefferson	2,383	1,158.05	37,551	32,010	249,505	73,251
Judith Basin	501	20.30	15,332	1,647	344,949	38,504
Lewis and Clark	1,410	1,410.19	21,958	24,546	169,303	60,623
Madison	1,185	1,061.40	13,611	8,638	260,211	53,009
Meagher	26	----------	56	1,235	4,940	595
Mineral	12	----------	311	----------	4,000	528
Park	32	.30	959	----------	8,368	1,318
Powell	308	290.70	9,184	359	74,119	18,139
Ravalli	2	2.51	1	----------	----------	53
Sanders	33	----------	1,153	834	26,554	3,006
Silver Bow	135,718	5,269.51	687,429	9,994,703	352	1,878,842
	149,251	12,867.66	944,384	10,121,648	1,697,826	2,360,497

By kinds of ore

Dry and siliceous	22,810	10,798.02	559,317	15,116	50,186	$603,952
Copper	121,313	1,121.98	265,016	10,060,635	----------	1,518,697
Lead	5,002	932.58	110,201	35,342	1,592,296	225,127
Copper-lead	126	15.08	9,850	10,555	55,344	12,721

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	
Dry and siliceous	22,810	0.473	24.52	0.03	0.11	$26.48
Copper:						
Oxidized	226	.499	5.92	12.02	----------	45.78
Sulphide	121,087	.008	2.18	4.13	----------	12.46
Lead:						
Oxidized	612	.210	15.31	.09	17.78	43.30
Sulphide	4,390	.183	22.97	.39	15.65	45.24
Copper-lead: Oxidized	126	.120	78.17	4.19	21.96	100.96
	149,251	.086	6.33	3.39	.57	15.82

PRODUCTION BY COUNTIES

GENERAL FEATURES

The pages that follow show the production reported by counties and the output of each important mining district. No mention is made of many districts in which production was small.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1924

County	Gold					Silver •	
	Placers		Deep mines		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Beaverhead	57.86	$1,196	134.24	$2,775	$3,971	77,547	$51,957
Broadwater	123.94	2,562	852.41	17,621	20,183	22,438	15,033
Cascade			772.45	15,968	15,968	637,816	427,337
Deer Lodge	14.61	302	2,685.30	55,510	55,812	77,615	52,002
Fergus			65.69	1,358	1,358	1,227	822
Granite	105.65	2,184	1,044.03	21,582	23,766	50,320	33,714
Jefferson	37.39	773	33,556.58	693,676	694,449	291,921	195,587
Judith Basin			296.49	6,129	6,129	115,505	77,388
Lewis and Clark	113.83	2,353	6,932.91	143,316	145,669	45,557	30,523
Lincoln	25.11	519	351.49	7,266	7,785	35,912	24,061
Madison	307.37	6,354	1,694.05	35,019	41,373	14,736	9,873
Meagher	12.72	263	8.80	182	445	926	620
Mineral	225.09	4,653	56.70	1,172	5,825	355	238
Missoula	19.20	397			397		
Park	2.56	53	10,044.01	207,628	207,681	2,318	1,553
Phillips			2,356.73	48,718	48,718	45,373	30,400
Powell	127.13	2,628	290.73	6,010	8,638	9,204	6,167
Ravalli	81.03	1,675	6.82	141	1,816	7	5
Sanders						1,153	773
Silver Bow	10.35	214	35,381.14	731,393	731,607	11,859,370	7,945,778
Sweet Grass	3.10	64			64		
Toole	56.65	1,171			1,171	3	2
Total, 1923	1,323.59	27,361	96,530.57	1,995,464	2,022,825	13,289,303	8,903,833
	1,972.68	40,779	83,106.75	1,717,969	1,758,748	13,380,862	10,972,307

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	191,027	$25,024	3,534,401	$282,752			$363,704
Broadwater	4,042	529	563,367	45,069	12,240	$795	81,609
Cascade	1,186,694	155,457	2,481,751	198,540	8,264	537	797,839
Deer Lodge	173	23					107,837
Fergus			1,192	95			2,275
Granite	32,189	4,217	14,555	1,164			62,861
Jefferson	325,509	42,642	806,698	64,536	374,027	24,312	1,021,526
Judith Basin	4,304	564	2,544,123	203,530			287,611
Lewis and Clark	31,213	4,089	512,651	41,012			221,293
Lincoln	377	49	1,198,721	95,898	244,800	15,912	143,705
Madison	9,151	1,199	267,210	21,377			73,822
Meagher	1,235	162	129,622	10,370			11,597
Mineral			4,000	320			6,383
Missoula							397
Park			8,368	670			209,904
Phillips			11,387	911			80,029
Powell	359	47	74,119	5,930			20,782
Ravalli							1,821
Sanders	834	109	26,554	2,124			3,006
Silver Bow	247,364,955	32,404,809	27,297,289	2,183,783	127,835,887	8,309,333	51,575,310
Sweet Grass							64
Toole							1,173
Total, 1923	249,152,062	32,638,920	39,476,008	3,158,081	128,475,218	8,350,889	55,074,548
	224,125,264	32,946,414	35,945,623	2,516,194	141,460,392	9,619,307	57,812,970

• Includes placer production.

Ore sold or treated, deep mines producing, and average value of ore in Montana, 1923–24

County	Ore, tailings, and slag sold or treated, 1924 (short tons)		Number of deep mines producing		Average value per ton [a]		Average value per ton in gold and silver [a]	
	Quantity	Increase or decrease	1923	1924	1923	1924	1923	1924
Beaverhead	36,842	+10,622	13	11	$9.24	$9.84	$2.49	$1.49
Broadwater	8,166	−3,320	20	26	7.23	9.68	3.03	4.00
Cascade	163,444	+52,505	17	10	6.13	4.88	4.21	2.71
Deer Lodge	12,590	−24,971	8	8	6.58	8.54	6.56	8.54
Fergus	104	−17	3	8	29.83	21.87	29.83	20.96
Granite	2,143	−5,627	36	17	37.86	28.31	32.93	25.79
Jefferson	93,691	+47,424	28	40	6.42	10.89	5.02	9.49
Judith Basin	26,354	+9,381	5	6	11.55	10.91	4.53	3.17
Lewis and Clark	25,599	−7,596	32	33	12.64	8.55	10.82	6.79
Lincoln	33,254	−11,728	2	2	4.96	4.31	1.31	.94
Madison	3,193	−2,465	48	58	15.04	21.12	12.09	14.05
Meagher	1,073	+956	4	3	31.55	10.56	9.98	.74
Mineral	117	+53	3	3	35.58	14.74	17.61	12.01
Missoula		−468	3		16.82		12.35	
Park	49,246	+4,700	2	5	3.88	4.26	3.83	4.25
Phillips	3,946	−91,219	2	2	3.01	20.28	3.01	20.05
Powell	308	−275	14	23	50.60	58.90	40.11	39.49
Ravalli	8	+4	1	2	23.75	17.75	23.75	17.75
Sanders	33	−39	5	1	71.12	91.09	20.51	23.42
Silver Bow	4,192,371	−1,068,973	58	44	10.36	12.30	1.96	2.07
	4,652,482	−1,091,053	304	302	10.06	11.83	2.21	2.34

[a] Value per ton, placer product excluded.

Number and production of producing placer mines in Montana, 1923–24

County	1923					1924				
	Mines		Gold	Silver	Total value	Mines		Gold	Silver	Total value
	Hydraulic and sluicing	Drift				Hydraulic and sluicing	Drift			
				Fine ounces					*Fine ounces*	
Beaverhead	4		$427	1	$428	8	1	$1,196	7	$1,201
Broadwater	5		667	6	672	7		2,562	21	2,576
Deer Lodge	1		130		130	2		302	1	303
Fergus	1		155	1	156					
Granite	9		8,227	117	8,323	5	1	2,184	25	2,201
Jefferson	3		213	5	217	5	1	773	14	782
Lewis and Clark	11	2	2,625	23	2,644	11	3	2,353	27	2,371
Lincoln						3		519	2	520
Madison	10		14,755	144	14,873	10		6,354	48	6,386
Meagher	1		599	4	602	2		263	3	265
Mineral	10		4,720	8	4,726	12		4,653	8	4,658
Missoula	3		608	2	610	1		397		397
Park	1		49		49		1	53		53
Powell	7		3,655	28	3,678	5		2,628	20	2,642
Ravalli	3		845	5	849	3		1,675	6	1,679
Sanders	1		39		39					
Silver Bow	4		2,773	14	2,784	1		214	2	215
Sweet Grass						1		64		64
Toole	2		292	2	294	2	1	1,171	3	1,173
	76	2	40,779	360	41,074	78	8	27,361	187	27,486

BEAVERHEAD COUNTY

Argenta district.—Two placers and four deep mines in the Argenta district yielded 128 tons of ore, $1,094 in gold, 1,017 ounces of silver, 517 pounds of copper, and 47,956 pounds of lead, valued in all at $5,679. The ore averaged $39.58 in metals a ton. Several lots of silver-lead ore were shipped from Mauldin, Midnight, and Ferdinand properties, near Dillon. Placer gold was mined from Watson Creek and Gold Run Gulch, near Argenta.

Bannack district.—Several small lots of especially rich gold ore were shipped from the Gold Bug property, and a little placer gold from surface operations was marketed.

Beaverhead district.—Three placers in the Beaverhead district yielded $308 in gold and 1 ounce of silver. Most of the output came from the Horse Prairie placer, which was later abandoned.

Blue Wing district.—Several lots of rich silver ore were shipped from the New Departure mine, near Dillon.

Bryant district (Melrose).—The Hecla Consolidated Mining Co., near Melrose, shipped several lots of copper-lead ore containing gold and silver. Most of the district output was from a large quantity of lead slag shipped from the Hecla dump. The Hecla was formerly one of the largest producers of lead in Montana.

Elkhorn district (Wise River).—The property of the Boston-Montana Corporation remained in the hands of a receiver, and the 750-ton milling plant was idle. Efforts were made to reorganize the company.

Vipond district.—The Argyle Silver Mining Co. has reserves of about 25,000 tons of silver ore and 12,000 tons of old tailings. Formerly the ore was treated by amalgamation, but a cyanidation plant is now planned.

BROADWATER COUNTY

Backer district (Canton).—Six placers and three deep mines in the Backer district produced 7 tons of ore, $4,891 in gold, 72 ounces of silver, and 325 pounds of lead, valued in all at $4,965. The ore averaged $349.57 in metals a ton and came mainly from the Slim Jim mine, near Canton, where a few tons of exceptionally rich gold ore were treated by amalgamation. The placer output, valued at $2,518, was largely from the Confederate Gulch, Eldorado Bar, and Cement Gulch placers, near Townsend and Watson.

Beaver district.—Three deep mines in the Beaver district produced 111 tons of ore, containing $301 in gold, 8,821 ounces of silver, 571 pounds of copper, and 71,014 pounds of lead, valued in all at $11,967. Most of the output was sulphide lead ore from the Little Olga and January properties, near Winston.

Cedar Plains district (Radersburg).—Fourteen deep mines in the Cedar Plains district yielded 7,899 tons of ore and slag, containing $13,073 in gold, 11,639 ounces of silver, 2,448 pounds of copper, and 459,373 pounds of lead, valued in all at $57,942, or $7.34 a ton. Except for 614 tons of first-class ore, most of the output was gold ore concentrated and old slag. Iron ore containing gold was milled at the Keating property, and the resmelting of slag from the Toston dump yielded considerable lead. Several cars of sulphide lead ore were

shipped from the Daisy Dandy property and also oxidized ore from the Santa Anita and Summit properties. Other shipments were made from the Ruby Silver, Ohio Keating, Silver Horse, Surprise, Cyclone, and Emma properties.

Park district (*Townsend*).—One placer and six deep mines in the Park district produced 149 tons of ore, $1,918 in gold, 1,906 ounces of silver, 1,023 pounds of copper, 32,655 pounds of lead, and 12,240 pounds of zinc, valued in all at $6,736. The ore had an average value of $44.82 in metals a ton. Several lots of siliceous silver ore containing gold and lead were shipped from the Moonbeam property. Lead-zinc ore from the Bamar property was shipped to the Timber Butte mill for a test. Small lots of ore were shipped from the Pittsburg, Little Fanny, and Liberty properties, and a little gold ore was treated by amalgamation at the Morning Glory mine.

CASCADE COUNTY

The Anaconda Copper Mining Co. continued refining, roasting, and leaching operations at Black Eagle, near Great Falls. The electrolytic zinc plant treated zinc ore and concentrate from Montana, Idaho, Utah, Nevada, and Canada; the zinc output averaged 6,500 tons a month. In 1924 the capacity of the plant was increased to 180,000,000 pounds yearly. Copper ore from the mines at Butte is milled and smelted at Anaconda. Copper anodes are shipped to Great Falls to be refined and made into copper wire and bars. Zinc ore and lead-zinc ore from the Butte mines are milled either at Butte or Anaconda and the resulting concentrate shipped to the electrolytic plant for leaching. The zinc residues from this plant go to the lead smelter at East Helena, Mont. The production is given in the report on the Anaconda Copper Mining Co., under Silver Bow County.

Montana district (*Neihart*).—Ten deep mines in the Montana district produced 163,444 tons of ore and slag, containing $15,968 in gold, 637,816 ounces of silver, 1,186,694 pounds of copper, 2,481,751 pounds of lead, and 8,264 pounds of zinc, valued in all at $797,839, or $4.88 a ton. The output consisted of 160,786 tons of ore milled, 1,131 tons of crude ore, and 1,527 tons of old slag. The largest part of the output was that of the Silver Dyke Mining Co., which treated copper-lead ore at its 500-ton concentration-flotation plant. Several hundred tons of crude copper-lead ore were shipped, but the main product was copper-lead concentrate and lead concentrate, which went to East Helena, Mont., and International, Utah. The company has an unusually large quantity of silver-copper-lead ore in reserve for future operations. The mine is opened by more than 6,000 feet of drifts and tunnels, and $60,000 worth of development work was done in 1924. Additional equipment was placed in the mill and several changes made in the flow-sheet to improve recovery. No details regarding operations are given in the report of the American Zinc, Lead & Smelting Co., which owns about 70 per cent of the company's stock, but costs for mining, milling, and smelting were reported to be about $2.75 a ton. Several hundred tons of slag, valuable chiefly for silver, were shipped from the dump of the old Silver smelter, near Great Falls. Sulphide lead ore rich in silver

was shipped from the Hartley, Florence, Galt, and Silver Belt properties, and siliceous silver ore, containing considerable gold, from the Big Seven and Benton properties.

DEER LODGE COUNTY

The smelting and milling plants of the Anaconda Copper Mining Co., at Anaconda, were active throughout the year. Copper ore from Butte and custom material from mines throughout the State were either concentrated or were smelted directly in the large copper plant equipped with reverberatories and converters. Lead-zinc mill ore was also concentrated at this plant and the resulting concentrate shipped to Great Falls to be treated in the electrolytic zinc plant. The results of smelting at Anaconda are given in the report on the Anaconda Copper Mining Co., under Silver Bow County.

Dry Gulch district.—A little placer gold was recovered from sluicing operations at the Dry Gulch placer, 10 miles north of Anaconda.

Georgetown district (*Southern Cross*).—Five deep mines in the Georgetown district yielded 3,717 tons of ore, containing $50,733 in gold, 155 ounces of silver, and 106 pounds of copper, valued in all at $50,851, or $13.68 a ton. Most of the output was oxidized iron ore containing gold mined at the Holdfast, Oro Fino, Short Shift, and Southern Cross mines. The Southern Cross mine, a large producer of gold previous to 1919, was worked by a lessee who was prospecting for ore in the adjacent claims. The Holdfast property produced about 1,000 tons of ore averaging more than an ounce of gold to the ton and is said to have considerable low-grade ore in reserve. Several lots of ore were shipped from the Twilight property, but the work was not profitable.

Oro Fino district.—Nearly 9,000 tons of milling ore from the Butte Jardine mine were treated by flotation in a 100-ton plant. The mine is developed by nearly 7,000 feet of drifts and tunnels and is said to have approximately 25,000 tons of ore in reserve. One lot of silver ore was shipped from the Cashier property, 9 miles from Race Track.

FERGUS COUNTY

The metal output from Fergus County has been steadily decreasing in recent years, but it was a large producer of gold from 1901 to 1920.

North Moccasin district (*Kendall*).—No mines in the North Moccasin district were continuously active. Bullion was marketed from a clean-up at the Barnes King mill and also from the old Whiskey Gulch mill. The Barnes King Development Co. disposed of all mine and mill machinery at both Kendall and Marysville, and early in 1925 the company was dissolved.

Warm Springs district (*Giltedge*).—Five deep mines in the Warm Springs district yielded 40 tons of ore, containing $275 in gold, 1,216 ounces of silver, and 1,192 pounds of lead, valued in all at $1,185. Several lots of silver ore were shipped from the Silver Queen, Florence, and Silver Bullion properties. The Maginnis Mining Co., a large producer of gold in the past, was idle, but a small lot of bullion resulted from a clean-up around the mill.

GRANITE COUNTY

A marked decrease in the quantity of the ore sold or treated in Granite County was shown in 1924 as well as in 1923. The value of the metal output decreased from $302,477 in 1923 to $62,861 in 1924.

Alps district.—A little gold ore from the Rainy Day mine was treated in the small 5-ton amalgamation mill.

Dunkleberg district.—The Forest Rose mine, near Jens, was operated by the Butte & Western Mining Co. which shipped one lot of sulphide lead ore to the smelter at East Helena. Concentration tests were being made in a new 15-ton flotation plant, and machinery to increase the capacity of the mill was ordered.

First Chance district (*Garnet*).—One placer and five deep mines in the First Chance district produced 566 tons of ore, $14,367 in gold, 801 ounces of silver, and 599 pounds of copper, valued in all at $14,982. The ore had an average value of $26.32 in metals a ton. Most of the output came from the Prafapo property, where gold ore was treated by amalgamation and concentration. Rich gold concentrate was shipped to Anaconda and gold bullion to the assay office at Helena. The company works the Red King, Red Cloud, and Robert Emmet claims, near Garnet. Unusually rich gold ore was also shipped from the Shamrock and Gold Center properties. A little placer gold was saved by sluicing creek gravel and old tailings in Barney Gulch.

Flint Creek district (*Philipsburg*).—Five deep mines in the Flint Creek district produced 1,290 tons of silver ore, containing $4,560 in gold, 47,723 ounces of silver, and 743 pounds of copper, valued in all at $36,631, or $28.40 a ton. The greater part of the output was shipped from the Pocahontas and Granite-Bimetallic properties. Other shipments were made from the Algonquin and Wenger mines. The marked decrease in the district output resulted from inactivity at the Granite-Bimetallic and the Philipsburg properties, formerly important producers of silver. The Philipsburg Mining Co. concentrated manganese ore; the concentrate was used in the manufacture of dry-cell batteries.

Red Lion district.—In the Surprise group, operated by the Badger Montana Mining Co., a vein containing gold ore was being developed by a tunnel that was 1,300 feet long at the end of the year.

Rock Creek district.—Considerable gold was obtained by hydraulicking at the Basin placer, in Basin Gulch, a tributary of Rock Creek. This placer was a fairly large producer of gold from 1913 to 1918.

South Boulder district (*Maxville*).—One placer and four deep mines in the South Boulder district yielded 192 tons of ore, $1,516 in gold, 1,455 ounces of silver, and 30,833 pounds of copper, valued in all at $6,530. The ore had an average value of $32.10 in metals a ton. Rich gold ore was shipped from the Center claim, sulphide copper ore from the Brooklyn, and several lots of oxidized copper ore from the Huffman property, worked by the Gold Coin Mining Co. The Montana placer, on Princeton Creek, near Maxville, produced a little placer gold.

JEFFERSON COUNTY

Shipments of rich ore and concentrate from the Jib mine, near Basin, made the value of the metal output of Jefferson County for 1924 about four times that for 1923.

Amazon district.—The output of the district consisted of several lots of siliceous silver ore from the Bismark and Pilot properties, near Amazon, and one lot of sulphide lead ore from the Cleveland mine.

Big Blackfoot district.—One lot of oxidized lead ore was shipped from the Lost Cabin mine, near Whitehall.

Boulder district.—Two placers and four deep mines in the Boulder district produced 1,278 tons of ore, $2,763 in gold, 27,100 ounces of silver, 13,853 pounds of copper, and 156,614 pounds of lead, valued in all at $35,264. The ore had an average value of $27.36 in metals a ton. The largest part of the output was sulphide lead ore, with a little siliceous ore, from the Baltimore mine, near Boulder, which was worked by lessees. One lot of lead ore was shipped from the Molly McGregor mine and a small lot of rich gold ore from the Streak of Luck property. A small production of placer gold came from the Lulu claim on Wilson Creek and a property on Boulder River.

Cataract district (Basin).—One placer and three deep mines in the Cataract district yielded 68,198 tons of ore, $677,488 in gold, 183,796 ounces of silver, 281,582 pounds of copper, and 214,495 pounds of lead, valued in all at $854,678. The ore had an average value of $12.53 in metals a ton. An unusually large production of gold ore resulted from the activity at the Katy mine and other claims operated by the Jib Consolidated Mining Co., near Basin. Several thousand tons of rich gold concentrate, as well as some first-class gold ore, were shipped to East Helena and Anaconda. The ore occurs in a fissure vein in granite, and the property is opened by more than 15,000 feet of shafts, crosscuts, drifts, and raises. More than 5,000 feet of development work was done in 1924. The 300-ton concentration-flotation plant built in 1923 and 1924 was active from March 1 to the end of the year. No detailed printed report for 1924 was issued by the company, although the mine yielded gold valued at $600,000, or more than any other mine in Montana. Several lots of sulphide lead ore were shipped from the Hattie Ferguson mine; a little placer gold was saved from workings in Basin Creek; and development work was planned for the Jib Apex and Jib Extension properties.

Colorado district (Wickes).—One placer and 11 deep mines in the Colorado district produced 3,263 tons of ore and slag, $6,202 in gold, 22,875 ounces of silver, 13,848 pounds of copper, 369,074 pounds of lead, and 357,205 pounds of zinc, valued in all at $76,086. The ore and slag had an average value of $23.29 in metals a ton. Lead-zinc ore from the Mount Washington mine, owned by the Angelica Mining & Development Co., was shipped to Butte for milling, after which the concentrate was shipped to Great Falls. The mine, which is opened by a shaft 800 feet deep and a tunnel 5,000 feet long, was active about six months. Several shipments of silver ore containing gold were made from the Blue Bird mine, and a little lead-zinc ore from the Ariadne property was treated at the Timber Butte custom mill at Butte. Other shipments, chiefly lead ore, were made from the

Blue Jacket, At Ease, Minah, and Moon properties, and several hundred tons of old slag were shipped from Corbin.

Elkhorn district.—Eight deep mines in the Elkhorn district yielded 20,631 tons of ore and old tailings, containing $5,453 in gold, 54,695 ounces of silver, 13,541 pounds of copper, and 2,382 pounds of lead, valued in all at $44,064, or $2.14 a ton. Most of the output was old tailings from the Elkhorn dump, which were treated by cyanidation. Solutions of varying strength were allowed to percolate through the feed for 84 hours, after which the silver and gold were precipitated on zinc shavings. About 125,000 tons of tailings containing 4 ounces of silver with a little gold remain for treatment. The Swissmont property, a large producer of gold in 1922 and 1923, became unprofitable, and the mine was closed late in 1923, but some gold from former work was marketed in 1924. It is planned to dismantle both the mine and mill. Small lots of ore were shipped from the Copper King, Elkhorn, Golden Curry, Moreau, Elkhorn Bulwer, and Tacoma claims.

Lump Gulch district (Clancey).—One placer and four deep mines in the Lump Gulch district produced 59 tons of ore, $209 in gold, 991 ounces of silver, 28 pounds of copper, 8,852 pounds of lead, and 16,822 pounds of zinc, valued in all at $2,679. A large part of the output was lead-zinc ore, which was shipped to Butte for concentration. Test lots of ore were shipped from the Little Nell, Revenue, and H. & M. claims. A little placer gold was mined at the Nugget claim, in Lump Gulch. Several lots of lead ore were shipped from the Midnight claim and one small lot of copper ore from the Rose Girl property, near Caldwell.

Woodland Park district.—Except for small test lots, the output consisted of several cars of gold ore from the Ballard property, 12 miles from Corbin.

JUDITH BASIN COUNTY

Barker district (Hughesville).—Six deep mines in the Barker district produced 26,354 tons of ore, containing $6,129 in gold, 115,505 ounces of silver, 4,304 pounds of copper, 2,544,123 pounds of lead, valued in all at $287,611, or $10.91 in metals a ton, this total being decidedly more than the $195,974 for 1923. The output consisted of 501 tons of first-class ore and 25,853 tons of mill ore; the latter was reduced to 5,468 tons of concentrate. Ore was shipped from the August No. 2, Blankship, Butler, and Liberty group; the largest production came from the Block P. Mining Co., which operated a 75-ton gravity concentration mill. Sulphide lead ore and several thousand tons of rich lead concentrate were shipped to East Helena for smelting. A large quantity of ore is held in reserve, consisting mainly of galena, sphalerite, and pyrite. Drifting and crosscutting, amounting to 6,000 feet, was done in 1924. Especial effort was made to block out enough ore to justify doubling the capacity of the mill.

LEWIS AND CLARK COUNTY

The amount of ore and old tailings produced in Lewis and Clark County in 1924 was 23 per cent less than in 1923; most of it was treated by cyanidation. The closing of the Shannon mine, at Marys-

ville, has seriously decreased the output of gold. Smelting at the lead plant at East Helena continued, and more than 6,000 tons of bullion a month were shipped east for refinement. Custom material from Montana, Idaho, Washington, and Canada was treated in 1924, but the bulk of it was sulphide lead material from the Coeur d'Alene region of Idaho.

Blue Cloud district.—The Wilkinson property, in Old Dominion Gulch, 6 miles west of Helena, shipped one lot of iron ore containing gold and silver.

Dry Gulch district.—Five placers and two deep mines in the Dry Gulch district produced 13 tons of ore, $1,397 in gold, and 9 ounces of silver, valued in all at $1,403. The Blue Jay, Jim Town, and Spratt placers were operated by drifting.

Gould district.—The old Gould property was idle, but a little bullion was recovered from a clean-up of the mill.

Grass Valley district.—Four deep mines in the Grass Valley district produced 41 tons of ore containing $33 in gold, 1,940 ounces of silver, and 654 pounds of lead, valued in all at $1,385. Small test lots of silver ore were shipped from the Carbon Hill, Nora Darling, and Gray Eagle properties.

Greenhorn district.—A little ore from the Umatilla mine, near Birdseye, was treated by amalgamation.

Heddleston district.—Considerable lead ore from the Mike Horse mine, owned by the Sterling Mining & Milling Co., was treated at a 100-ton concentrator, and several hundred tons of lead concentrate were shipped early in the year; then operations ceased.

Helena district.—Four deep mines in the Helena district produced 47 tons of ore, containing $629 in gold, 397 ounces of silver, and 13,596 pounds of lead, valued in all at $1,983. A little oxidized lead ore was shipped from the Dudley property.

Lincoln district.—A little gold was marketed from the Harvey and Bloom placers, near Lincoln.

Ottawa district (Marysville).—Two placers and seven deep mines in the Ottawa district yielded 15,478 tons of ore and old tailings, $127,563 in gold, 20,374 ounces of silver, 427 pounds of copper, and 13,491 pounds of lead, valued in all at $142,349. The ore and tailings had an average value of $9.19 in metals a ton. The value of the output was less than half that of 1923 because of the closing of the mines formerly worked by the Barnes King Development Co. The output consisted of 602 tons of first-class smelting ore, 950 tons of old tailings, and 13,926 tons of ore treated in gold and silver mills. The largest part of the output came from the Drumlummon mine, where gold ore containing considerable silver was treated in a 75-ton cyanidation plant equipped for fine grinding and agitation. Part of the year the mine was operated by lessees and several cars of rich gold ore were shipped for smelting. The resumption of activities and the building of a new power plant at the Drumlummon property, which was unwatered and worked in July, in part offset the drop in the output of the Shannon and Piegan Gloster mines, from which only a mill clean-up was marketed in 1924. These mines have been worked by the Barnes King Development Co. since 1915 and have yielded gold and silver valued at more than $3,000,000. The company issued no report for 1924, but all mine and mill machinery was

sold, and early in 1925 the company was dissolved and a liquidation dividend paid. Some old tailings from the Drumlummon dumps were treated by cyanidation, and one lot of silver-lead ore was shipped from the Towsley and Nile properties.

Scratch Gravel district.—The output of the Scratch Gravel district consisted of one lot of gold ore from the Nettie mine and several lots of silver ore from the Silver Coin property. Development work continued at the Scratch Gravel mine, a producer of gold in 1918.

Stemple district.—A little ore was treated by amalgamation at the Stemple prospect.

Unionville district.—About 100 cubic yards of material around the old Whitlatch mill were treated by placer operations.

Vaughn district (*Rimini*).—Two placers and eight deep mines in the Vaughn district produced 5,578 tons of ore, $13,592 in gold, 10,556 ounces of silver, 201 pounds of copper, and 137,314 pounds of lead, valued in all at $31,675. The largest output was that of the Porphyry Dike mine, near Rimini, where several thousand tons of gold ore were treated by amalgamation. The Lee Mountain mine produced several hundred tons of sulphide lead ore and silver ore. Other shipments of lead ore were made from the Loeber Lode, Matt Carroll, Little Lily, and Valley Forge properties. At the Red Mountain property placer gold was recovered by hydraulicking glacial drift.

Wolf Creek district.—The Montana Copper & Zinc Co., which owns the New Era mine, shipped several lots of oxidized copper ore.

LINCOLN COUNTY

Libby district.—The output of the Libby district consisted of placer gold from the Cherry Creek and Liberty properties and lead concentrate from the Hazel T. mine, where several thousand tons of lead ore were treated in a 150-ton mill, although the property was active only a part of the year.

Troy district (*Callahan Creek*).—The Snow Storm Silver-Lead Co., operating a 400-ton mill equipped for concentration and flotation, was the only important producer in the Troy district. About 1,500 tons of lead concentrate and lead-zinc concentrate were shipped to East Helena and Great Falls, but the mill was active only part time. Considerable development work was done in drifting and sinking from the lower tunnel. It was reported that lead ore of good grade had been opened 200 feet below the No. 7 level, and work was planned to open the vein at depth on several levels. The Callahan group, on Callahan Creek, yielded a little placer gold by sluicing.

MADISON COUNTY

The value of the metal output of Madison County decreased from $99,968 in 1923 to $73,822 in 1924. From 1902 to 1922 the county yielded a large quantity of gold through the operation of dredges in Alder Gulch, the dredge production of the district in 1915 exceeding $800,000.

Alder Gulch district (*Virginia City*).—Five placers and eight deep mines in the Alder Gulch district produced 439 tons of ore,

$10,120 in gold, 4,264 ounces of silver, and 86 pounds of copper, valued in all at $12,988. The ore was valued at $18.45 in metals a ton, and the placer output was $4,864 in gold and 38 ounces of silver. No dredges were busy in the district, but sluicing was carried on at the Eggert and other placers in the vicinity of Virginia City. Prospecting was done by the Virginia City Lava Cap Mining Co., which reported, after much test drilling on various claims, a large deposit of gravel said to average more than $1 a cubic yard. Several lots of ore containing gold and silver were shipped from the Alhambra, Alameda, Tariff, and U. S. Grant properties. A little rich gold ore and gold bullion from the High Up mine, owned by the Greenback Co., were marketed. Operations were not continued, as development proved that the ore was too low grade to be treated profitably by cyanidation.

Bone Basin district.—From the Colorado property one lot of gold ore was shipped, and from the Florence mine several hundred tons of lead ore containing considerable gold. The ore is shipped from Renova, on the Northern Pacific Railroad.

Camp Creek district.—A little lead ore was shipped from the Calvin property, near Melrose.

Lower Hot Springs district (Norris).—Four small lots of ore were shipped from the Stratton, Silver Queen, and Mascot claims, near Norris.

McCarthy Mountains district.—One lot of gold ore was shipped from the Hidden Treasure property and oxidized silver-lead ore from the B. B. and I. E. mine, near Twin Bridges.

Mineral Hill district.—Three deep mines in the Mineral Hill district produced 66 tons of ore, containing $1,513 in gold, 91 ounces of silver, and 371 pounds of copper, valued in all at $1,623. Except for small lots of gold ore, the output consisted mainly of ore from the Strawberry mine treated by amalgamation and concentration. The property was operated only a short time, but gold bullion, first-class gold ore, and gold concentrate were marketed. At the Jimsey placer construction work was done on a pipe line and ditch, but there was not enough water to remove both the overburden and the gravel by hydraulic mining. The Liberty Montana Mining Co. operated the Mammoth, Leviathan, and Bismark mines, 16 miles south of Jefferson Island, and repaired the concentration-flotation mill formerly owned by the Montana Illinois Copper Mining Co.

Rabbit district.—Three deep mines in the Rabbit district yielded 74 tons of ore, containing $902 in gold, 547 ounces of silver, and 9,958 pounds of lead, valued in all at $2,065. Several lots of lead ore were shipped from the Monitor and Hemlock mines and a little gold bullion and concentrate from a clean-up of an old mill.

Sheridan district.—Five deep mines in the Sheridan district produced 694 tons of ore, containing $5,591 in gold, 1,318 ounces of silver, 1,391 pounds of copper, and 21,369 pounds of lead, valued in all at $8,366, or $12.05 a ton. Most of the gold output was from the operations at the Tamarack property, where the ore was treated in a 15-ton amalgamation mill. The mine is reported to have 10,000 tons of ore in reserve, but the mill ran only a few months. Several lots of sul-

phide lead ore were shipped from the Buckeye group, on Mill Creek, 3 miles east of Sheridan. At the Emma B. mine, of the Smuggler Mining Co., about 10,000 tons of gold ore, for which a mill is needed, is said to be in reserve.

Silver Star district.—One lot of gold ore from the Edgerton mine was shipped to Anaconda.

Summit district (Virginia City).—Four deep mines in the Summit district produced 707 tons of ore, containing $3,509 in gold, 556 ounces of silver, and 142 pounds of lead, valued in all at $3,893. Very low-grade gold ore was treated by amalgamation at the Winnetka property, but the loss in milling made operation unprofitable. The E. M. Smith Mining Co., near Alder, conducted experiments on ore and old tailings. The property is equipped with a 10-stamp amalgamation and concentration plant, and leaching tanks for cyanidation were erected in 1924. One car of gold ore was shipped from the Wakusta property, and ore was treated by amalgamation at the Meadow View mine.

Tidal Wave district (Twin Bridges).—Fourteen deep mines in the Tidal Wave district produced 339 tons of ore and slag, containing $2,619 in gold, 2,320 ounces of silver, 1,303 pounds of copper, and 84,530 pounds of lead, valued in all at $11,106, or $32.76 a ton. Most of the output was old slag from Twin Bridges; the remainder comprised small lots of first-class ore from various properties. Lead ore was shipped from the King, Arizona, Sunflower, Dutchland, and Ella mines, and gold ore from the Corncracker, High Ridge Fraction, and Lottie claims.

Unorganized (Madison River) district.—A little placer gold was mined from the banks of the West Fork of the Madison River, near Monida.

Upper Hot Springs district.—One lot of copper ore containing gold and silver was shipped from the Blue Grouse mine, near Norris, and one small lot of gold ore from the Bull Moose claim.

Washington district.—Five deep mines in the Washington district yielded 201 tons of ore, containing $3,494 in gold, and 712 ounces of silver, valued in all at $3,971. From the Missouri mine, worked for a short period under lease, gold bullion and concentrate were shipped to Anaconda and Helena. A little gold ore was shipped from the Lone Star and High Bluff mines and one lot of gold and silver ore from the Frisbee mine.

MEAGHER COUNTY

Beaver Creek district.—A little placer gold was mined from the Klondyke and Geho claims on Beaver Creek, and amalgamation tests of ore from the F. & A. mine were made.

Castle Mountain district.—Lead slag shipped from the dump of the Cumberland mine, near Lennep, constituted the output of the Castle Mountain district.

Musselshell district.—On the property of the Mountain Mines (Inc), where considerable copper-lead-zinc ore is said to be blocked out, a concentration mill was being erected, and 300 feet of development work was done in 1924. The mine is 4 miles from White Sulphur Springs.

MINERAL COUNTY

Cedar Creek district (*Iron Mountain, Quartz*).—Eleven placers and one deep mine yielded 100 tons of ore, $5,675 in gold, and 43 ounces of silver, valued together at $5,704. The placer output, valued at $4,557, was mined chiefly at the Bear, Cedar Creek, Meadow Creek, C. B. & Q., Marguerite, Stockholm, and Stemwinder properties, near Superior and Rivulet.

Iron Mountain district.—One lot of sulphide lead ore was shipped from the Iron Mountain mine, north of Superior.

St. Regis district.—The Lenora Gold Mining Co. made a small test of gold ore by amalgamation and erected a 25-ton Hardinge ball mill. Sluicing at the Orofino claim, on Deer Creek, gave a small output of placer gold. Drifting continued at the Amazon Dixie mine, where a large deposit of ore containing silver, copper, and lead is opened 1,500 feet below the surface.

MISSOULA COUNTY

Ninemile district.—Exceptionally fine placer gold was mined from the Scott claim, near Stark.

Wallace district.—The Missoula Mining Association, operating the Hidden Treasure mine, near Clinton, was building a 150-ton concentration plant, and a large output is expected in 1925.

PARK COUNTY

Crevasse district.—The George B. prospect, near Jardine, yielded gold ore which was treated by amalgamation in a 2-stamp mill. Considerable gold was produced from Crevasse Mountain in the nineties and from 1905 to 1909.

New World district (*Cooke*).—One car of silver-lead ore was shipped from the Irma mine, at Cooke City, where a replacement deposit in limestone is being opened by a 700-foot drain tunnel, 400 feet of which were driven in 1924. Tunneling to develop copper ore was continued at the properties of the Cooke Consolidated Copper Co. and the Western Smelting & Power Co. The latter is equipped with an aerial tramway and a 300-ton smelting plant that has been in course of construction for several years. A large deposit of copper ore is said to have been opened in the Montana Scotch Bonnet mine of the Glengarry Mining Co.

Sheepeater district (*Jardine*).—The Jardine Mining Co. continued development at Jardine and treated considerable gold ore by amalgamation and concentration in a 200-ton plant. As the ore also contains arsenic, a 16-foot McDougall furnace and large crude arsenic kitchens were completed during the year. After part of the gold has been saved by amalgamation and the ore is concentrated the concentrates are roasted in the arsenic plant and the residues shipped to East Helena to save the remaining gold. The Jardine mine was the third largest producer of gold in Montana in 1924. An excerpt from the company's annual report for 1924 follows:

> The mine responded so generously to development work that, notwithstanding the large tonnage extracted and milled, at the end of the year there was more ore in sight than at its commencement. While it is not considered good

mining practice to put too large a tonnage of ore in sight, due to the expense of maintaining openings until such time as ore is ready to be extracted, the development during the year was kept well ahead of mining, so that at all times there was a sufficient tonnage of ore available to keep the milling plant running to capacity. There are already 7 miles of workings in the mine, extending over a length of 2,300 feet along the vein system. In this area there have been developed six veins, only two of which are being worked at the present time. Some of the others are quite extensively developed and are held in reserve for future ore supply. * * *

Important developments of ore were made in both the extreme north and the extreme south ends of the mine. In the south end, in what is known as tunnels A and B, large ore bodies of arsenical gold ore have been developed and are being worked; they supplied a good portion of the mill tonnage during the latter part of the year. * * * In general, the ore in the south end of the mine averages about $6 in gold per ton and about 5 per cent arsenic.

In the north end of the mine tunnel No. 22, 645 feet in length, was finished during the year, and a raise from it encountered the old Legal Tender ore body, which was worked by our predecessors from the surface down only to the level of tunnels 4 and 6, approximately 280 feet on the dip of the vein. The ore on the new levels is being developed, and a large body averaging 8 feet in width has been exposed. * * *

The 40-stamp mill of the company was operated continuously during 1924. The capacity is being increased by the addition of concrete foundations under the stamps. * * *

The concentrates, after being roasted to extract the arsenic, are called calcines. The gold in the original concentrates remains in these calcines, which up to the present time have been shipped and sold to smelters. The cost of hauling, freight, and treatment, together with the amount lost in selling gold to the smelters, has been a large item of expense. Laboratory tests at Jardine show that these calcines can be treated by the cyanide process, and a cyanide plant has been constructed and is now ready to be put in operation. It is expected that this will decrease the cost of realizing on the gold in the calcines by 50 per cent. * * * It will take a little time and some experimenting to get a satisfactory extraction by cyanidation, but when the process is in full operation the company will have a self-contained plant independent of smelters or other works.

PHILLIPS COUNTY

Little Rockies district (*Landusky, Phillips*).—The Ruby Gulch Mining Co., at Zortman, a large producer of gold in the past, was idle. The Unit Leasing Co. reopened the August mine, 1 mile north of Landusky, remodeled the mill, and treated a large quantity of ore containing gold and silver by concentration and cyanidation. The district is famous as a producer of low-grade ore, but recent work in the August mine has evidently opened ore of better grade.

POWELL COUNTY

Big Blackfoot district.—Placer gold from the Gold Dust claim, on Ogden Mountain, and small lots of gold ore from the High Ore and Welch claims were marketed.

Mary Ann district.—The Gray Rock mine, near Elliston, which is opened by a tunnel 250 feet long, produced one lot of lead ore which reached the smelter early in 1924.

Nigger Hill district.—Ten deep mines in the Nigger Hill district yielded 66 tons of ore, containing $1,592 in gold, 1,443 ounces of silver, and 20,967 pounds of lead, valued in all at $4,236. One lot of gold ore containing silver was shipped from the Big Dick mine and small lots of lead ore from the O. K., Flora, Emilda, Montana, Big Bluff, Dandy Jim, Marion, and Packy McFarland mines.

Ontario district (*Elliston.*)—One placer and four deep mines in the Ontario district produced 41 tons of ore, $1,814 in gold, 958 ounces of silver, and 9,336 pounds of lead, valued in all at $3,203. The ore had an average value of $73.85 in metals a ton. One lot of lead ore, containing considerable gold and silver, was shipped from the Black Jack claim and gold and silver ore from the Democrat and Ontario properties. A little placer gold was obtained by sluicing at the Eddie placer, near Elliston.

Pioneer district (*Gold Creek*).—Three placers in the Pioneer district yielded $1,469 in gold and 12 ounces of silver, valued together at $1,477. The Friday placer, on Gold Creek, was worked from May to August and the Pioneer placer for three months.

Zozell district.—Six deep mines in the Zozell district produced 159 tons of ore, containing $2,434 in gold, 5,086 ounces of silver, 359 pounds of copper, and 15,994 pounds of lead, valued in all at $7,168, or $45.08 a ton. A little lead ore was shipped from the Emma Darling, Emery Consolidated, and Bertha May claims, gold ore from the Bonanza property, and silver ore from the Katy and Blue Eyed Maggie mines. From 1891 to 1905 the Emery Consolidated property yielded nearly 15,000 tons of lead ore containing about an ounce of gold to the ton. Deeper development on the Blue Eyed Maggie, which joins the Emery on the west, is planned for 1925.

RAVALLI COUNTY

Curlew district.—Exploratory work, consisting of 1,200 feet of tunnels and drifts, was done by the Curlew Mining Co., which has much ore and old tailings in reserve.

Hughes Creek district.—Three placers and two deep mines in the Hughes Creek district produced 8 tons of ore, $1,816 in gold, and 7 ounces of silver, valued together at $1,821. The placer output came from the Lalor claim and other placers on Hughes Creek. A little gold ore from the Jim & Star property was treated by amalgamation, and a test lot was shipped from the Overwich claim.

SANDERS COUNTY

Thompson River district.—One car of silver-lead ore was shipped from the Silver King mine, near Thompson Falls.

SILVER BOW COUNTY

Eleven companies produced the larger part of the metal output of Silver Bow County in 1924. As the large producing mines at Butte were active throughout the year, the quantity of metals produced was decidedly increased. The larger part of the ore mined was concentrated at milling plants at Butte and Anaconda; the resulting product consisted of copper concentrates, copper-lead-zinc concentrates, zinc concentrates, and lead-zinc concentrates, containing metals valued at $49,008,063, or $32.04 a ton of concentrates. The crude smelting ore averaged $13.84 in metals a ton. No ore was treated by amalgamation or cyanidation, but 141,907 tons of old tailings were re-treated by concentration and 17,362 tons of copper

tailings and slag were smelted. Of the total output of ore, tailings, and slag in the county, 82 per cent was classified as copper material.

Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., in 1924

	Number of producers	Ore, tailings, and slag	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ozs.*	*Pounds*	*Pounds*	*Pounds*	
1924	45	4,192,371	$731,607	11,859,370	247,364,955	27,297,289	127,835,887	$51,575,310
Increase or decrease from 1923	−17	−1,068,973	+104,022	+21,895	+24,321,884	+1,795,549	−13,176,726	−2,920,317

[a] Includes placer production.

Divide Creek district (*Melrose*).—One lot of gold ore from the Alice property and a small lot of copper ore from the Ruby Mountain claim were shipped.

German Gulch district.—A property in German Gulch marketed a little placer gold, but the Montana Gold Mountain Mining Co. was idle, as there was not enough water for mining.

Summit Valley or Butte district.—Forty-two deep mines in the Butte district produced 4,192,353 tons of ore, old tailings, and slag, containing $730,646 in gold, 11,859,290 ounces of silver, 247,364,350 pounds of copper, 27,296,937 pounds of lead, and 127,835,887 pounds of zinc, valued in all at $51,574,188, or $12.30 a ton. The output consisted of 3,897,384 tons of ore, which was reduced to 1,529,696 tons of concentrates, 135,700 tons of first-class ore, principally copper ore, and 159,269 tons of old tailings and slag.

From the beginning of activities in 1882 to the end of 1924 Silver Bow County, which includes the Butte district, has yielded gold, silver, copper, lead, and zinc valued at $1,841,531,619, as follows: Gold, $33,705,198; silver, $294,618,232; copper, $1,340,002,109; lead, $12,392,390; and zinc, $160,813,690. These values represent 1,630,488.91 ounces of gold, 399,801,572 ounces of silver, 8,622,814,852 pounds of copper, 190,993,837 pounds of lead, and 1,876,718,111 pounds of zinc.

The mines of the Anaconda Copper Mining Co.[2] produced 3,092,151 tons of ore and 6,654 tons of precipitates, a total of 3,098,805 tons in 1924 against 2,823,561 tons in 1923. The concentrator treated 3,079,178 tons of ore, 78,753 tons of copper tailings, and 55,880 tons of zinc-silver tailings. The copper-reduction works at Anaconda treated, for all companies, 3,312,775 tons of ore. Of this material 3,017,417 tons came from company mines, 212,319 tons were either purchased from or treated for other companies, 19,659 tons came from the old plants at Anaconda and Great Falls, and 63,379 tons from the zinc plant at Great Falls. The Anaconda works produced 238,823,149 pounds of fine copper, 8,383,591 ounces of silver, and 37,688.81 ounces of gold. Of this output 238,247,038 pounds of copper, 8,345,841 ounces of silver, and 37,688.81 ounces of gold were produced for the Anaconda Co.

[2] Anaconda Copper Mining Co. Ann. rept. for year ended Dec. 31, 1924.

The electrolytic copper refinery at Great Falls produced 209,966,554 pounds of cathodes, most of which were melted into shapes at Great Falls. The total output of copper rods for the year was 107,931,230 pounds. Of this quantity 40,101,844 pounds were manufactured into wire, 15,559,986 pounds of which were made into strand. The copper-leaching plant at Anaconda, which is fully described in a monthly publication [3] of the Anaconda Copper Mining Co., remained closed throughout the year. The zinc plants at Anaconda and Great Falls treated 599,275 tons of ore and other zinciferous material; 58,229 tons of the total were produced by mines of the Anaconda Co., and 541,046 tons of ore and concentrates were purchased from other companies. The plant at Great Falls produced 154,390,391 pounds of electrolytic zinc, 5,433,330 pounds of zinc in dross, and residue from which 23,810,201 pounds of lead, 1,892,097 pounds of copper, 3,628,863 ounces of silver, and 5,603.69 ounces of gold were recovered. The capacity of this plant was increased to 180,000,000 pounds of zinc per annum, and further expansion was planned for 1925. Dividends amounting to $2,250,000 were paid in 1924 by the Anaconda Co., and the net income for the year was $6,719,215, which, added to the balance at the end of the year 1924, gives a surplus of $74,520,665 after deduction of dividends.

The company also is engaged in lumbering, mines coal, and manufactures arsenic, sulphuric acid, fertilizer, and metal roofing. Through its subsidiaries it operates a copper and lead plant at International, Utah, a copper smelter at Miami, Ariz., a lead refinery at East Chicago, Ind., as well as zinc-oxide plants at Akron, Ohio, and East Chicago, Ind. No statement was made regarding the development work and the ore reserves of the Butte mines, but considerable work was done, especially in deepening the shafts of the Mountain Consolidated, Badger State, Rarus, and Pennsylvania mines. It was planned to sink the Pennsylvania shaft to a depth of 3,600 feet. Early in the year the Berkeley and Tramway mines were closed, but in December the Original mine, which had been idle more than a year, was reopened. Unusually rich silver-copper ore was said to have been opened at depth in the Rarus and other mines.

The Anselmo Mining Co. made a large output of copper-lead-zinc ore and copper ore, and is now an important producer of silver, zinc, and copper. Both grades of ore were concentrated at Anaconda and the resulting concentrates smelted or leached at Anaconda or Great Falls. Development work in crosscuts, drifts, raises, and shaft sinking amounted to about 600 feet for the year.

The Anaconda Copper Mining Co., as lessee, operated the Emma and Ophir properties belonging to the Butte Copper & Zinc Co. Manganese ore was shipped to eastern plants, and lead-zinc ore was milled at Anaconda. The property was a large producer of zinc, lead, and silver. From 100,760 tons of ore of all classes $155,952 was received. The net income for the year was $133,112. After payment of dividends of $300,000 in December the surplus was $416,782. An excerpt from the report of the Butte Copper & Zinc Co. for 1924 follows:

> Despite the fact that the prices of zinc and lead advanced only slightly during the year 1924, the results of operations showed a decided improve-

[3] The Anode, August, 1923.

ment over the preceding year. * * * The developments during the year have been quite extensive and satisfactory. In the intermediate levels a number of good bodies of commercial ore have been opened up and on the 1,200-foot level ore of exceptionally high values has been developed. We look with confidence during the coming year toward producing from these rich ore bodies a better grade of ore than has lately been sent to the concentrator. * * * The prices for zinc and lead, especially the latter, seem to be on the upgrade, and this, with the hoped for better grade of zinc ores and the possibilities of a much larger manganese ore production, leads us to believe that the year 1925 will be a satisfactory one.

The Evelyn mine, which is opened by a 500-foot shaft and 300 feet of drifts and crosscuts, yielded first-class silver ore and lead-zinc ore of milling grade. Several hundred tons of copper ore from the Butte Ramsdell property, which was under lease to the Davis Daly Copper Co., were shipped to the East Butte plant for milling and smelting.

The Butte & Superior Mining Co. was active the entire year, making regular shipments of copper ore and lead-zinc ore to Anaconda. The property is opened by a 3,000-foot shaft and by nearly 50 miles of drifts. During the current year 20,809 feet of development work was done. The concentration-flotation plant, formerly operated by the company, was idle and all the ore was shipped to Anaconda for milling. The company received $2,969,261 from the sale of ore in 1924, and the cost of mining was $2,504,282, leaving an operating profit of $464,979, or a net income of $209,372 without deduction for depletion. No dividends were paid in 1924, though the property has paid $17,375,554 in dividends to date. The company's annual report for 1924 contains these paragraphs:

Aside from acquisition of the property of Butte-New York Copper Co. through foreclosure, there was no change in the company's property holdings during the year except the purchase of some surface rights for waste dump purposes.

Sinking of No. 3 shaft during the year amounted to a total of 289 feet, or 102 feet below the 3,000 level. As soon as the skip chute is completed development work will be started on the 3,000 level. * * *

The total zinc ore produced during the year amounted to 294,858 tons, containing a total of 1,158 ounces of gold, 1,113,247 ounces of silver, 1,353,291 pounds of copper, 9,107,991 pounds of lead, and 58,499,014 pounds of zinc, or an average assay of 0.004 ounce of gold, 3.78 ounces of silver, 0.23 per cent of copper, 1.54 per cent of lead, and 9.92 per cent of zinc.

The production of copper ore amounted to 167,312 tons, containing a total of 713 ounces of gold, 1,059,760 ounces of silver, and 13,797,257 pounds of copper, or an average assay of 0.004 ounce of gold, 6.33 ounces of silver, and 4.12 per cent of copper. (The report does not give the contents of the concentrates made at Anaconda.)

During the year several ore blocks, which on further development proved to be too low grade to be economically mined, were abandoned—47,536 tons from the previously regarded commercial zinc ore reserves and 13,113 tons from the copper ore reserves. * * *

The estimated ore reserves at the end of 1924 follow: Zinc ore of commercial grade, 327,966 tons, averaging 14.6 per cent of zinc and 4.92 ounces of silver; zinc ore of noncommercial grade, 205,720 tons, averaging 8.14 per cent of zinc and 2.15 ounces of silver; copper ore, 304,030 tons, averaging 3.8 per cent of copper and 6.11 ounces of silver.

Contracts for the disposition of both zinc and copper ore were consummated during the year for a long period of time on a basis more economical to this company than would be the result of operating its own mill on such a comparatively small tonnage. The mill, partially obsolete, no longer required for operation, is being dismantled in order to take advantage of its salvage value to remove serious fire hazards to mining facilities.

On March 12 the property of the Davis Daly Copper Co. was sold to the Anaconda Copper Mining Co., after which liquidation dis-

tributions were made. In January and February the Colorado property yielded some copper ore of milling grade which was shipped to the East Butte plant, and the Hibernia produced silver ore and lead-zinc ore which was milled at the Timber Butte mill, at Butte.

The East Butte Copper Mining Co. operated its 500-ton smelter and 800-ton concentration plant east of Butte until August 10; then closed them. Stoping in the Pittsmont mine was discontinued early in August, and for the rest of the year only development work was done. Ore from the Davis Daly property was shipped to Anaconda after March, and loss of this ore was a severe blow to the East Butte smelter and mill, as the supply of ore from the East Butte mine was not sufficient for economical operation. The company mined 74,044 tons of ore, averaging 3.85 per cent of copper and 2.18 ounces of silver to the ton. At Butte 67,366 tons of company ore and 15,576 tons of custom material were either milled or smelted, while 5,862 tons of ore were shipped to Anaconda. The production was 519 ounces of gold, 257,026 ounces of silver, and 7,140,220 pounds of copper, valued at $1,182,869, but as the expense exceeded the income, the deficit on all operations was $161,393. The annual report of the company for 1924 says:

> The year's operation resulted in a loss which is traceable principally to metal prices considerably under pre-war prices and to decreasing production of first-class ores. We would, however, call your attention to the strong financial condition of the company, showing, as it does, substantially $1,200,000 in quick assets. * * *
>
> Following the closing of the Pittsmont reduction plants early in August, and the resultant discontinuance of production from stopes in the mine, a carefully planned development program designed principally to prospect for and develop the extensions of ore bodies reasonably expected beneath the 1,500 and 1,800 levels was promptly put into effect. When this program is finished, it is estimated that a tonnage will have been developed well in excess of that extracted during the year.
>
> Development work this far on the 1,800 and 2,000 levels has established the downward extensions of "12," "16," "30," "45," and "60" veins. * * *
>
> One of the outstanding features of the year's events at Butte was the inauguration of hoisting operations through the new No. 4 shaft. By the 1st of May the installation of a complete hoisting unit and all the shaft connections with the various levels in the mine were completed, and hoisting operations were promptly transferred from the No. 2 shaft to the new shaft. Very satisfactory results have been obtained from the operation of this shaft and ventilation and working conditions greatly improved since it was completed. * * *
>
> In view of the general improvement in business conditions throughout the country and the advance in metal prices, the mining of ore in the stopes was resumed in February, 1925. We were able to obtain a smelting contract from the Anaconda Company for the treatment of our ores at figures considerably under our own smelting costs. As a consequence our reduction plants will remain idle, and ore shipments are now being made to the Anaconda Company's smelting plant at Anaconda.

The Elm Orlu Mining Co. property at Butte was active throughout the year and was a large producer of silver, zinc, and lead. The output was chiefly a lead-zinc ore treated in the Timber Butte plant, south of Butte. The zinc concentrate and lead-zinc concentrate were shipped to the electrolytic plant at Great Falls. About 20,000 feet of development work was done, mainly in crosscuts, drifts, and raises. Details regarding production, ore reserves, and costs are not published.

The Goldsmith mine, worked by the Crystal Copper Co., was opened to a depth of 850 feet. Several thousand tons of first-class silver ore were shipped to Anaconda, as well as a little low-grade lead-zinc ore for concentration.

More than 8,000 tons of silver ore containing a little gold were shipped from the Minnie Jane mine, operated by the Butte West Side Mines Co. The mine is opened by a 200-foot shaft, 2,000 feet of drifts, and a 600-foot crosscut, and yields minerals characteristic of the properties west of Butte—argentite, quartz, pyrite, rhodochrosite, rhodonite, sphalerite, and galena.

The Poser mine, worked through the Elm Orlu shaft, was a large producer of both silver and zinc. A large quantity of lead-zinc ore was shipped to the Timber Butte mill. The Moulton mine, which is opened by nearly 14,000 feet of drifts, crosscuts, and raises, was active the entire year; ore treated at the Timber Butte mill yielded several thousand tons of lead and zinc products which were shipped.

During the course of development the Midwest Butte Development Co. shipped about 2,000 tons of lead-zinc ore to the mills at Butte and Anaconda. The milling companies pay for 72 per cent of the gold, silver, and lead, and 65 per cent of the zinc contained in the milling ore.

The mines of the North Butte Mining Co., a large producer of copper in the past, were worked only through lessees, who shipped several thousand tons of copper ore to Anaconda for milling or smelting. The company received $105,298 from the sale of ore, but the loss for the year was $167,322, which included expense for development of property in Arizona. The following is taken from the company's printed report for 1924:

> Under contract with leasors for the mining of ore adjacent to the Speculator shaft and between the 400 level and the 1,000 level, there was produced during the year 6,004 wet tons of ore and treated at the smelter 5,825 dry tons of ore; 3,196 dry tons first-class, 2,519 dry tons second-class, and 110 dry tons third-class. This ore produced 576,111 pounds of fine copper, 37,750.09 ounces of silver, and 40,248 ounces of gold. * * *
>
> No mining was done by the company during the year, and the mines will remain closed down until there is a decided advance in the price of copper metal. * * *
>
> Development at depth of 2,000 feet in the Butte East Side district just east of the main strand of the Continental fault in the workings driven from Butte Main Range shaft has disclosed what promises to be important ore bodies of good grade ore existing on claims which are contiguous to a large area of mineral ground owned by the company, and it will probably be advisable to plan later to explore in vicinity of these newly discovered ore bodies rather than prosecute further work at Superior, Ariz.

The Tuolumne Copper Co. made no shipments but opened high-grade ore from the 2,000-foot level. The annual report for 1924 states:

> On February 27 operations were resumed at the Main Range mine. The surface plant was completely overhauled and put in good working condition, following which the unwatering of the property was begun. During that period, when operations were completely suspended, the mine filled with water from the 2,200-foot level to the 1,700-foot level. Two months were required to complete the unwatering of the workings, after which a considerable amount of repair work was necessary on the 500, 700, 1,200, 1,600, 2,000, and 2,200 foot levels. * * *

The following is a statement of development work done during the year: 2,485 feet mainly in crosscutting and 4,050 cubic feet in station cutting. * * *

Development work during the year 1924 was confined to the 2,000-foot level. A crosscut was driven northwesterly from the shaft on the 2,000-foot level for a distance of 200 feet, and in this working an east-west vein was cut on which 60 feet of drifting has been done. This vein is heavily mineralized, and further drifting on it should result in the development of commercial ore.

During the year 1923 drifts were driven on the Spread Delight vein for a distance of 1,125 feet. From these drifts the vein was crosscutted at a number of points which disclose the vein width of from 50 to 100 feet. * * *

Ore is being produced from the development of No. 1 vein east of the Continental fault. The drift on this vein is being extended easterly, and with an advance of about 200 feet the intersection of this vein with the Rory O'More and other veins to the north should be reached. No. 1 vein where crosscutted showed a width of 2 feet of solid ore assaying 13.7 per cent copper and 33.2 ounces of silver per ton. In the face of the drift which has been started on this vein the ore is of higher grade and gives promise of greater width.

The drift east on the Spread Delight vein has been cleaned up and will be extended through the fault and a crosscut driven to intersect this vein east of the fault. This is the easterly extension of the largest copper-silver vein of the Butte district, and with the additional geologic depth obtained east of the fault should carry large shoots of high-grade primary copper-silver ores.

In addition to the work on the 2,000-foot level a crosscut will be driven on the 2,200-foot level to the Spread Delight vein and a drift extended easterly in this vein through the fault. From this drift crosscuts will be extended northerly and southerly to develop that entire section of your property lying east of the fault, including those veins in which high-grade ore has been proven on the 2,000-foot level.

While this work is being prosecuted on the 2,000 and 2,200 foot levels, the Main Range shaft will be sunk from the 2,200-foot level to the 2,800-foot level and lateral development extended to develop the veins both east and west of the Continental fault on the 2,400-foot and 2,800-foot levels.

At Anaconda concentrates from old copper tailings and slimes and also from old zinc tailings re-treated, yielded considerable copper and silver. The Minnie Irvine, Non-Consolidated, Venus, Brewer Lode, and Cripple mines reported a fair output, followed by the Black Hawk, Butte Los Angeles, Little St. Lawrence, Narrow Gauge, Brittania, Elba, Brilliant, General Sheridan, Glengarry, Gregory, Lincoln, Mammoth, Northern Pacific, Snowstorm, and Yellow Jacket claims.

SWEET GRASS COUNTY

A little placer gold was recovered from a property near Big Timber.

TOOLE COUNTY

Gold Butte district.—Placer gold was recovered by drifting at the Jessie No. 1 and Banner claims, near Gold Butte.

COPPER

By Helena M. Meyer[1]

INTRODUCTION

The production of metallic copper usually requires three distinct operations—mining, smelting, and refining. Different processes are used in each of the three operations, but ordinarily the preparation of the ore for smelting is the most varied and complicated. There is no considerable American source of copper, except the Lake Superior native copper ores, in which these three operations are not necessary. It is therefore possible to determine approximately the copper production of the United States by three separate sets of statistics, which may be obtained, respectively, from the mines, the smelters, and the refineries. These three sets of figures will never agree exactly, but each set has for certain purposes a particular advantage over the others, and the three together show the dominant features of the copper industry.

The mine figures make it possible to determine best the geographic distribution of production and are also the only source of accurate data on the character and quantity of the ore, its content of copper and precious metals, and the degree to which it is concentrated before smelting. They show the estimated recoverable copper content but of course not the quantity of copper that will be recovered by the smelters. The smelter statistics show with fair accuracy the geographic distribution of the production and give the exact quantity of copper recovered from the ores, including considerable copper recovered from sulphur, lead, zinc, and siliceous ores that carry so little copper that the mines are not paid for it and do not report it. The refinery statistics show accurately the quantity of copper made available for consumption and the precious metals obtained in refining, but they do not show the distribution of the production among the States of origin and they are even uncertain in their separation of the material refined into foreign and domestic. One difference between the mine and the smelter figures may be produced by a difference in the quantity of ore, matte, or other material held in stock at the smelter at the beginning and the end of the year, and one difference between the smelter and the refinery statistics may be produced by a difference in the quantity of unrefined copper in stock at the refinery at the beginning and the end of the year.

The main cause of differences between the three sets of figures, however, is the difference in time of the successive stages of production of refined copper. The interval between the time the ore is mined and the time the refined copper is available for commercial use is ordinarily two or three months. It is therefore clear that refinery sta-

[1] Statistics of imports and exports have been compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

tistics for the calendar year 1924, for example, cover ore that was mined probably between October, 1923, and October, 1924. Consequently, a decided slump or a decided stimulation at the beginning or the end of any year would cause a marked difference in the three sets of figures, but during periods of normal operation there should be no great difference between them.

As the smelter figures permit reasonably accurate determination of the distribution of copper as to source by States and give the actual output of copper, the smelter output is adopted in this report as the production of the country. It is made up of the output of blister and of furnace-refined or ingot copper of the Lake district.

SUMMARY OF DOMESTIC AND WORLD STATISTICS

Summary of statistics of the copper industry in the United States, 1919–1924

	1919	1920	1921
Production of copper:			
Smelter output—pounds	1,286,419,329	1,209,061,040	505,586,098
Mine production—do	1,212,334,041	1,224,550,151	466,190,853
Refinery production of new copper—			
Electrolytic—do	1,233,994,324	1,010,240,867	506,532,984
Lake—do	177,594,135	153,483,952	100,918,001
Casting and pig—do	21,897,336	18,698,421	1,963,271
Total domestic—do	1,433,485,795	1,182,423,240	609,414,256
Total domestic and foreign—do	1,770,168,041	1,526,165,346	950,777,815
Total new and old copper—do	2,345,000,000	2,151,000,000	1,385,000,000
Ore produced:			
Copper ore—short tons	36,121,622	36,765,370	13,396,382
Average yield of copper—per cent	1.65	1.63	1.70
Copper-lead and copper-zinc ores—short tons	17,632	26,890	14,248
Average price per pound—cents	18.6	18.4	12.9
Imports (unmanufactured)—pounds	429,387,594	485,670,691	350,472,611
Exports of metallic copper [a]—do	515,595,019	623,158,489	628,415,714
Withdrawn from total supply on domestic account:			
Total new copper—pounds	914,471,572	1,053,838,558	610,988,744
Total new and old copper—do	1,489,000,000	1,679,000,000	1,046,000,000
Stocks at end of year:			
Refined copper—do	631,000,000	659,000,000	459,000,000
Blister and materials in solution—do	273,000,000	465,000,000	283,000,000
World's production—do	2,191,394,000	2,114,349,000	1,229,277,000
Value of smelter production from domestic ores	$239,274,000	$222,467,000	$65,221,000

	1922	1923	1924
Production of copper:			
Smelter output—pounds	950,285,947	1,434,999,962	1,634,249,192
Mine production—do	964,583,894	1,477,739,709	1,606,165,018
Refinery production of new copper—			
Electrolytic—do	766,944,836	1,302,454,492	1,499,223,447
Lake—do	122,545,126	137,691,306	145,333,227
Casting and pig—do	15,180,723	24,019,197	29,657,925
Total domestic—do	904,670,685	1,464,164,995	1,674,214,599
Total domestic and foreign—do	1,255,515,959	1,979,835,616	2,260,076,010
Total new and old copper—do	1,927,000,000	2,802,000,000	3,037,000,000
Ore produced:			
Copper ore—short tons	26,893,247	45,519,317	49,178,315
Average yield of copper—per cent	1.74	1.58	1.59
Copper-lead and copper-zinc ores—short tons	52,370	162,181	219,874
Average price per pound—cents	13.5	14.7	13.1
Imports (unmanufactured)—pounds	541,013,220	676,473,338	768,813,731
Exports of metallic copper [a]—do	742,755,957	828,854,827	1,116,775,136
Withdrawn from total supply on domestic account:			
Total new copper—do	896,633,833	1,300,473,331	1,354,742,564
Total new and old copper—do	1,568,000,000	2,122,000,000	2,131,000,000
Stocks at end of year:			
Refined copper—do	216,000,000	264,000,000	243,000,000
Blister and materials in solution—do	361,000,000	432,000,000	393,000,000
World's production—do	1,870,747,000	2,710,653,000	2,945,423,000
Value of smelter production from domestic ores	$128,289,000	$210,945,000	$214,087,000

[a] Total exports of copper, exclusive of ore, concentrates, and composition metal, and in 1923 and 1924 of unrefined copper, figures for which are not separable from those for ore and concentrates.

Copper produced in the United States from domestic ores, 1919–1924

[Smelter output, in pounds fine]

State	1919	1920	1921	1922	1923	1924
Alaska	56, 534, 992	66, 093, 924	76, 808, 114	59, 900, 579	68, 648, 368	77, 053, 492
Arizona	536, 515, 368	552, 988, 731	155, 165, 656	428, 200, 634	615, 493, 561	672, 365, 115
California	23, 548, 698	11, 822, 028	15, 906, 883	20, 440, 430	27, 042, 835	49, 433, 716
Colorado	4, 892, 558	4, 282, 616	6, 592, 598	3, 635, 916	4, 343, 418	4, 158, 612
Georgia	8, 306	3, 663		8, 147		
Idaho	3, 966, 655	1, 922, 116	1, 971, 623	3, 504, 944	3, 664, 079	3, 148, 519
Maine	376, 186		3			
Michigan	177, 594, 135	153, 483, 952	100, 918, 001	122, 545, 126	137, 691, 306	145, 333, 227
Missouri	588, 570	533, 368	137, 591	1, 070, 259	217, 449	184, 947
Montana	176, 289, 873	177, 743, 747	49, 471, 206	165, 341, 414	224, 353, 764	249, 322, 394
Nevada	64, 683, 734	55, 580, 322	15, 129, 116	20, 398, 611	63, 495, 928	77, 281, 479
New Mexico	60, 377, 320	52. 159, 751	18, 076, 909	29, 127, 329	57, 521, 171	78, 145. 629
North Carolina	3, 334				61, 913	
Oregon	2, 808, 017	2, 529, 311	274, 934	925, 954	1, 182, 437	716, 656
Pennsylvania		618, 361		888, 721	1, 121, 573	1, 263, 535
South Carolina	2, 297					
South Dakota	8, 631	2, 190			47	4, 199
Tennessee	15, 629, 454	16, 727, 803	15, 084, 294	14, 226, 232	18, 721, 932	18, 251, 996
Texas	2, 153	14, 217	587	3, 889	4, 216	302
Utah	143, 836, 304	110, 357, 748	45, 831, 959	79, 665, 563	210, 118, 291	256, 531, 349
Vermont	582, 561					
Washington	2, 552, 134	2, 125, 586	598, 658	369, 133	839, 254	978, 647
Wyoming	150, 051	24, 256	9, 830		87, 686	
Undistributed	15, 467, 998	47, 350	3, 608, 136	33, 066	390, 734	75, 378
	1, 286, 419, 329	1, 209, 061, 040	505, 586, 098	950, 285, 947	1, 434, 999, 962	1, 634, 249, 192

World's production of copper (smelter output), 1920–1924, in metric tons[a]

[Figures are taken from official sources so far as possible. For countries from which ore or matte was exported for smelting official figures have been converted to figures showing the quantity of copper recoverable by the smelters]

Country[b]	1920	1921	1922	1923	1924
Canada	37, 014	21, 600	19, 450	39, 409	47, 381
Cuba	[c] 8, 400	[c] 8, 200	[c] 11, 800	[c] 11, 000	[c] 10, 800
Mexico	49, 192	15, 228	26, 978	53, 372	49, 113
United States	548, 426	229, 332	431, 047	650, 912	741, 283
North America	643, 032	274, 360	489, 275	754, 693	848, 577
Bolivia	9, 982	10, 592	10, 531	10, 049	7, 439
Chile	98, 952	59, 239	129, 575	182, 384	[d] 187, 324
Peru	32, 982	33, 284	36, 408	44, 166	34, 923
Venezuela	[c] 400	[c] 800	[c] 1, 700	[c] 800	[c] 600
South America	142, 316	103, 915	178, 214	237, 399	230, 286
Austria	1, 645	4, 277	4, 593	4, 833	3, 848
Bulgaria	[c] 200	[c] 600	[e] 1, 000	[e] 1, 000	[e] 1, 000
England	129	73	106	89	123
Finland	[c] 460	[c] 200	[c] 750	[c] 507	[c] 368
Germany	14, 976	15, 514	17, 733	18, 467	19, 500
Italy	635	356	319	494	356
Norway	556	1, 348	80	67	71
Portugal	[c] 1, 000	[c] 1, 600	[c] 600	[c] 400	[c] 700
Rumania	[e] 165	[e] 108	[e] 111	[e] 71	[e] 90
Russia	3, 751	4, 668	2, 000	2, 000	3, 300
Spain	22, 458	36, 345	25, 139	45, 266	36, 346
Sweden	1, 289	1, 149			
Yugoslavia	2, 436	4, 144	5, 354	6, 788	8, 101
Europe	49, 700	70, 382	57, 785	79, 982	73, 803
China	[f] 191	[f] 958	[f] 313	[f] 849	[f] 842
India, British	520	1, 161	1, 054	190	(g)
Japan	67, 792	54, 092	54, 126	59, 346	63, 056
Taiwan	692	1, 197	1, 096	707	227
Asia	69, 195	57, 408	56, 589	61, 092	64, 125

[a] Prepared by L. M. Jones, of the Bureau of Mines.

[b] In addition to the countries shown, Chosen is reported to have produced 5,368 metric tons of crude copper in 1920. Just what material this "crude copper" includes can not be determined.

[c] Estimated by the Bureau of Mines.

[d] Preliminary.

[e] For year ended Mar. 31 following that stated in heading of column.

[f] Exports of ingots and slabs.

[g] Data not available.

World's production of copper (smelter output), 1920–1924, in metric tons—Continued

Country	1920	1921	1922	1923	1924
Algeria	e 430	e 300	e 430	e 460	e 350
Belgian Congo	18,962	30,464	43,362	57,886	85,570
Rhodesia:					
Northern	132	200	181	132	82
Southern	2,820	2,794	3,074	2,697	2,565
Southwest African Protectorate	c 4,369	6,529	6,279	9,044	7,744
Union of South Africa	1,075	92	665	8,150	8,113
Africa	27,788	40,379	53,991	78,369	104,424
Australia	27,022	11,147	12,703	17,997	14,807
Grand total	959,053	557,591	848,557	1,229,532	1,336,022

e Estimated by the Bureau of Mines.
c For year ended Mar. 31 following that stated in heading of column.

GENERAL CONDITIONS

Production and consumption in 1924 broke by a wide margin the high records of 1923 for production and consumption in time of peace. Smelter production and withdrawals on domestic account in 1924 were surpassed only in 1916, 1917, and 1918 and the refined production from domestic and foreign sources only in 1917 and 1918. During 1924 consumption exceeded production, and stocks of refined and blister copper decreased 60,000,000 pounds. The year's record production was made in spite of the fact that the average price of copper was, with the single exception of 1921, the lowest recorded since 1911. Copper monthly prices ranged from a low of 12.49 cents a pound in June to a high of 14.32 cents a pound in December, according to figures of the American Metal Market. Sentiment improved considerably during the last quarter of the year, partly owing to the results of the American and British elections. The average price for the year as reported to the division of mineral resources by selling agencies was 13.1 cents a pound. Imports of copper in 1924 attained a new high record, a total of 768,813,731 pounds being imported, as compared with 676,473,338 pounds in 1923, the previous year of highest record. Exports of metallic copper, 1,116,775,136 pounds, fell 8,872,200 pounds below those of 1917 but except for those were the highest ever recorded. In 1924 the imports were over two-thirds as large as the exports, whereas in 1913 they were not one-half as large. This fact indicates that the greater part of the large increase in production is being consumed in the United States. Large as consumption in this country is, it is bound to be much larger because of the electrification of railroads, expansion in the hydroelectric field, and increased demand from many industries. Had foreign consumption increased in the same proportion as domestic there might have been less cause for dissatisfaction in regard to prices, although if European demand had been large, production, which in the United States has been considerably below capacity, would have expanded materially and a higher level for prices might not have resulted. Europe, in spite of unsettled political conditions in several countries that are large consumers, is now taking increasing quantities of copper.

In May, 1924, Representative James, of Michigan, introduced a bill in Congress providing a duty of 6 cents a pound on copper im-

ported. Congress took no action on this bill. In years since the war the producers of copper have had to accept a lower scale of prices than those current for other commodities, and therefore a large number of them have made records in lowering costs of production. The efficient organizations that have been built in response to the necessary cutting of costs will enable producers to make money by selling at prices that would not have yielded profits in the past. During the year many companies decidedly improved their recoveries of copper from ore, especially the recoveries by flotation, as is indicated by the tables in the section on operations by States and companies. A number of companies obtained higher recoveries, although treating ores of lower grade. At some plants where improvements were not in effect early enough in the year to increase notably the average recovery for the year the recovery in the last quarter of the year was decidedly higher than in the first quarter.

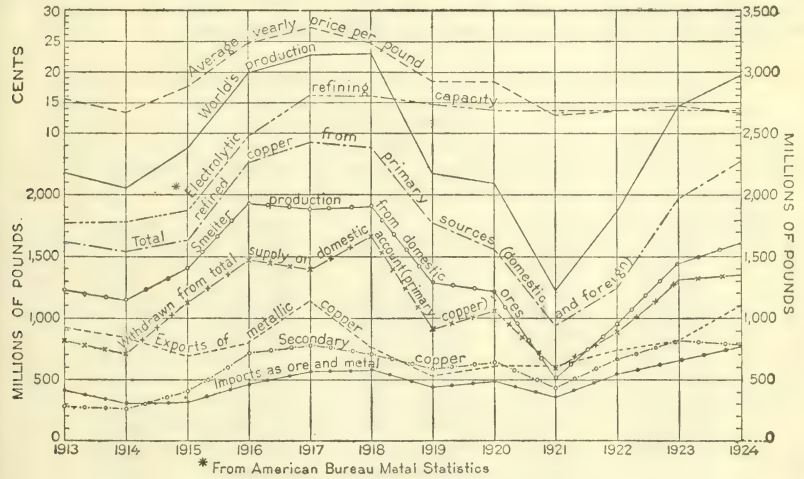

FIGURE. 12.—Chief features of the copper industry, 1913–1924

Chile and the Belgian Congo also established in 1924 a new record for copper production by exceeding the high record of 1923. In 1924 Chile produced 187,324 metric tons, compared with 182,384 tons in 1923 and 42,263 tons in 1913, and the Belgian Congo produced 85,570 metric tons, compared with 57,886 tons in 1923 and 7,407 tons in 1913. The Chile Copper Co. will probably not expand its production further until the price for copper is higher. The Union Minière du Haut-Katanga, on the other hand, has made plans for much larger production. The plans include a leaching plant and reverberatory furnace smelter in the Congo, and an electrolytic refinery in Belgium. This company has overcome huge obstacles in bringing its property into successful operation and is still having trouble with labor and transportation problems.

In 1924 there were no large consolidations as there were in 1923. The much-rumored merger of the Ray-Inspiration interests did not take place, seemingly because of the inability of the companies interested to agree on the terms of a transfer of stock.

PRODUCTION

SMELTER PRODUCTION

The smelter production of copper from domestic ores rose from 1,434,999,962 pounds, valued at $210,945,000, in 1923, to 1,634,249,192 pounds, valued at $214,087,000, in 1924. The increase of 14 per cent in quantity and only 1 per cent in value indicates a decided decrease in the average price. Smelter production in 1924 exceeded the figures for all previous years except 1916, 1917, and 1918 and establishes a record peace-time production. This production is 293,601,356 pounds behind the all-time record of 1,927,850,548 pounds in 1916.

A feature of interest is the relation that the smelter production from domestic ores in the United States bears to the world's production. In 1913 the copper made from domestic ores in the United States represented 56 per cent of the total world output; in 1918, 61 per cent; in 1920, 57 per cent; in 1921, 41 per cent; in 1922, 51 per cent; in 1923, 53 per cent; and in 1924, 55 per cent.

Copper produced (smelter output) in the United States, 1845–1924

[Values rounded]

Year	Quantity	Increase	Value	Year	Quantity	Increase	Value
	Pounds	*Pounds*			*Pounds*	*Pounds*	
1845	224,000		$45,000	1886	157,763,043	*8,112,440	$17,512,000
1846	336,000	112,000	57,000	1887	181,477,331	23,714,288	25,044,000
1847	672,000	336,000	124,000	1888	226,361,466	45,440,942	38,029,000
1848	1,120,000	448,000	218,000	1889	226,775,962	414,496	30,615,000
1849	1,568,000	448,000	349,000	1890	259,763,092	32,987,130	40,523,000
1850	1,456,000	*112,000	320,000	1891	284,121,764	24,358,672	36,368,000
1851	2,016,000	560,000	334,000	1892	344,998,679	60,876,915	40,020,000
1852	2,464,000	448,000	542,000	1893	329,354,398	*15,644,281	35,570,000
1853	4,480,000	2,016,000	985,000	1894	354,188,374	24,833,976	33,648,000
1854	5,040,000	560,000	1,108,000	1895	380,613,404	26,425,030	40,726,000
1855	6,720,000	1,680,000	1,814,000	1896	460,061,430	79,448,026	49,687,000
1856	8,960,000	2,240,000	2,419,000	1897	494,078,274	34,016,844	59,289,000
1857	10,752,000	1,792,000	2,688,000	1898	526,512,987	32,434,713	65,288,000
1858	12,320,000	1,568,000	2,833,000	1899	568,666,921	42,153,934	97,242,000
1859	14,112,000	1,792,000	3,104,000	1900	606,117,166	37,450,245	100,615,000
1860	16,128,000	2,016,000	3,709,000	1901	602,072,519	*4,044,647	100,546,000
1861	16,800,000	672,000	3,696,000	1902	659,508,644	57,436,125	80,460,000
1862	21,160,000	4,360,000	4,655,000	1903	698,044,517	38,535,873	95,632,000
1863	19,040,000	*2,120,000	6,473,000	1904	812,537,267	114,492,750	104,005,000
1864	17,920,000	*1,120,000	8,422,000	1905	888,784,267	76,247,000	138,650,000
1865	19,040,000	1,120,000	7,473,000	1906	917,805,682	29,021,415	177,136,000
1866	19,936,000	896,000	6,828,000	1907	868,996,491	*48,809,191	173,799,000
1867	22,400,000	2,464,000	5,682,000	1908	942,570,721	73,574,230	124,419,000
1868	25,984,000	3,584,000	5,976,000	1909	1,092,951,624	150,380,903	142,084,000
1869	28,000,000	2,016,000	6,790,000	1910	1,080,159,509	*12,792,115	137,180,000
1870	28,224,000	224,000	5,977,000	1911	1,097,232,749	17,073,240	137,154,000
1871	29,120,000	896,000	7,023,000	1912	1,243,268,720	146,035,971	205,139,000
1872	28,000,000	*1,120,000	9,956,000	1913	1,224,484,098	*18,784,622	189,795,000
1873	34,720,000	6,720,000	9,721,000	1914	1,150,137,192	*74,346,906	152,968,000
1874	39,200,000	4,480,000	8,624,000	1915	1,388,009,527	237,872,335	242,902,000
1875	40,320,000	1,120,000	9,152,000	1916	1,927,850,548	539,841,021	474,288,000
1876	42,560,000	2,240,000	8,937,000	1917	1,886,120,721	*41,729,827	514,911,000
1877	47,040,000	4,480,000	8,937,000	1918	1,908,533,595	22,412,874	471,408,000
1878	48,160,000	1,120,000	7,994,000	1919	1,286,419,329	*622,114,266	239,274,000
1879	51,520,000	3,360,000	9,582,000	1920	1,209,061,040	*77,358,289	222,467,000
1880	60,480,000	8,960,000	12,943,000	1921	505,586,098	*703,474,942	65,221,000
1881	71,680,000	11,200,000	13,046,000	1922	950,285,947	444,699,849	128,289,000
1882	90,646,232	18,966,232	17,313,000	1923	1,434,999,962	484,714,015	210,945,000
1883	115,526,053	24,879,821	19,062,000	1924	1,634,249,192	199,249,230	214,087,000
1884	144,946,653	29,420,600	18,843,000				
1885	165,875,483	20,928,830	17,915,000		34,127,190,671		5,714,604,000

* Decrease.

The figures of smelter production in 1924 are based on confidential returns from all known smelting companies handling copper-bearing materials from the United States. To all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries concerning distribution of the output sincere thanks are extended. The following list gives the names of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1924. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters can be found in the chapters on those metals.

Copper reduction plants that treated materials from the United States in 1924[a]

Location	Company	Final copper product
Arizona:		
Ajo	New Cornelia Copper Co	Electrolytic.
Clarkdale	United Verde Copper Co	Blister.
Do	United Verde Extension Mining Co	Do.
Douglas	Calumet & Arizona Mining Co	Do.
Do	Phelps Dodge Corporation	Do.
Globe	Old Dominion Co	Do.
Hayden	American Smelting & Refining Co	Do.
Humboldt	Southwest Metals Co	Do.
Miami	International Smelting Co	Do.
Clifton	Phelps Dodge Corporation	Do.
Superior	Magma Copper Co	Do.
California: Kennett	United States Smelting, Refining & Mining Co	Do.
Maryland: Baltimore	Baltimore Copper Smelting & Rolling Co	Electrolytic.
Michigan:		
Hancock	Quincy Mining Co	Anodes and lake.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Mining Co	Do.
Montana:		
Anaconda	Anaconda Copper Mining Co	Blister.
Butte	East Butte Copper Mining Co	Do.
Great Falls	Anaconda Copper Mining Co	Electrolytic.
Nevada: McGill	Nevada Consolidated Copper Co	Blister.
New Jersey:		
Chrome	United States Metals Refining Co	Blister and electrolytic.
Maurer	American Smelting & Refining Co	Blister, electrolytic, and casting.
Newark	Balbach Smelting & Refining Co	Casting.
Perth Amboy	Raritan Copper Works	Electrolytic.
New York: Laurel Hill	Nichols Copper Co	Blister and electrolytic.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Sulphur, Copper & Iron Co. (Ltd.)	Do.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Garfield	Garfield Smelting Co	Do.
International	International Smelting Co	Do.
Virginia: West Norfolk	Norfolk Smelting Co	Do.
Washington: Tacoma	American Smelting & Refining Co	Blister and electrolytic.

[a] This list does not include a smelter in Pennsylvania, which made blister from material solely of foreign origin.

During the year 32 copper smelting and refining plants treated material from the United States; all of these were domestic plants. The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. As to blister copper, the figures represent the fine copper content. Some casting and electrolytic copper is produced direct from ore or matte, and this is included in the smelter production. Metallic and cement copper recovered by leaching is also included in smelter production.

MINE PRODUCTION

The figures of mine production are based on reports furnished to the Bureau of Mines by all mines producing copper. The mines and smelters of several of the large copper producers are under the same management, and their production is reported on the same basis. The figures furnished by mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion are likely to differ considerably from the smelter returns, as the mines may report a considerable quantity that has not reached the stage of blister copper by the end of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters in the following year. This discrepancy is more pronounced if a marked curtailment of production occurs at the beginning or the end of the year, so that there is not the balance of overlap that occurs if the industry is in normal condition throughout the year. Considerable copper is recovered by the smelters from ores that are treated primarily for

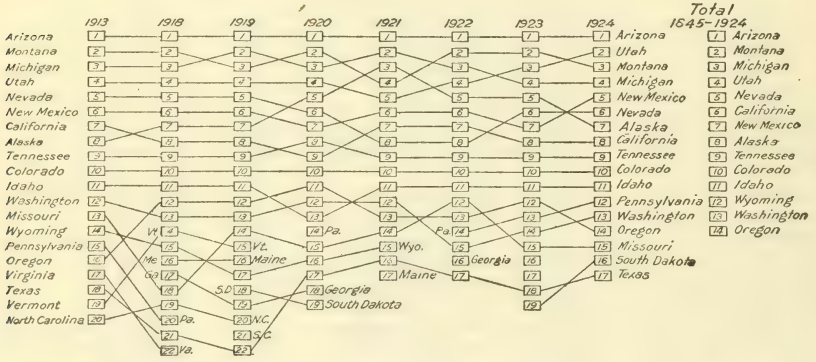

FIGURE 13.—Rank of States producing copper, 1913, 1918–1924, and 1845–1924

other metals, the copper content being so low that it is not paid for and consequently is not always reported by the mines. The difference between the smelter and the refinery production is accounted for entirely by an increase in the stocks of blister copper plus the copper content of bluestone produced and the loss in refining.

Detailed figures on ore production in 1923 which were not available when the 1923 report on copper was prepared are included in this report, and the 1925 report will contain detailed ore figures for 1924.

Copper produced from domestic ores as reported by mines, smelters, and refineries, 1918–1924, in pounds

Year	Mine	Smelter	Refinery
1918	1,910,022,841	1,908,533,595	1,882,874,191
1919	1,212,334,041	1,286,419,329	1,433,485,795
1920	1,224,550,151	1,209,061,040	1,182,423,240
1921	466,190,853	505,586,098	609,414,256
1922	964,583,894	950,285,947	904,670,683
1923	1,477,739,709	1,434,999,962	1,464,164,995
1924	1,606,165,018	1,634,249,192	1,674,214,599

PRODUCTION BY STATES

Sixteen States and one Territory contributed to the smelter production of copper in 1924. The subjoined table shows the mine and the smelter output of individual States for 1923 and 1924.

Copper produced in the United States, 1923 and 1924, according to smelter and mine returns, by States, in pounds

State	1923		1924			
	Smelter returns	Mine returns	Rank	Smelter returns		Mine returns
				Percentage of total	Quantity	
Alaska	68,648,368	85,920,645	7	4.72	77,053,492	74,074,207
Arizona	615,493,561	618,928,602	1	41.14	672,365,115	677,752,013
California	27,042,835	28,317,759	8	3.03	49,433,716	52,107,171
Colorado	4,343,418	4,248,109	10	.25	4,158,612	2,713,219
Idaho	3,664,079	3,979,631	11	.19	3,148,519	2,738,824
Michigan	137,691,306	138,304,080	4	8.89	145,333,227	135,662,605
Missouri	217,449	202,556	15	.01	184,947	182,811
Montana	224,353,764	224,125,264	3	15.26	249,322,394	249,152,062
Nevada	63,495,928	67,204,282	6	4.73	77,281,479	73,805,323
New Mexico	57,521,171	61,356,802	5	4.78	78,145,629	74,691,436
North Carolina	61,913	61,983				
Oregon	1,182,437	1,283,476	14	.04	716,656	768,395
Pennsylvania	1,121,573	1,703,480	12	.08	1,263,535	1,114,694
South Dakota	47		16		4,199	
Tennessee	18,721,932	18,721,932	9	1.12	18,251,996	18,335,635
Texas	4,216	4,257	17		302	
Utah	210,118,291	222,393,572	2	15.70	256,531,349	242,138,165
Washington	839,254	871,999	13	.06	978,647	928,458
Wyoming	87,686	111,280				
Undistributed	390,734				75,378	
	1,434,999,962	1,477,739,709		100.00	1,634,249,192	1,606,165,018

Copper produced in the United States, 1845–1924, by States

[Smelter output]

State	Pounds	Percentage	Rank
Alaska	880,860,023	2.58	8
Arizona	10,216,985,243	29.94	1
California	893,102,034	2.62	6
Colorado	302,743,132	.89	10
Idaho	124,768,157	.36	11
Michigan	7,366,947,763	21.59	3
Montana	8,700,412,043	25.49	2
Nevada	1,118,684,452	3.28	5
New Mexico	880,997,524	2.58	7
Oregon	18,374,941	.05	14
Tennessee	[a] 449,753,000	1.32	9
Utah	2,954,878,164	8.66	4
Washington	19,882,104	.06	13
Wyoming	31,672,806	.09	12
Other States and unapportioned	167,129,285	.49	
	34,127,190,671	100.00	

[a] Approximate production.

The three States that have made the largest production are Arizona, Montana, and Michigan. These three States together have produced about 77 per cent of the output of the United States.

Mine production of copper in the principal districts in 1923

District or region	State	Mine output (pounds)	Percentage of total production	Rank
Butte	Montana	223,043,000	15.09	1
Bingham	Utah	216,037,000	14.62	2
Globe-Miami	Arizona	198,426,000	13.43	3
Jerome	do	140,425,000	9.50	4
Lake Superior	Michigan	138,304,000	9.36	5
Bisbee (Warren)	Arizona	123,884,000	8.38	6
Copper River	Alaska	74,527,000	5.04	7
Ely (Robinson)	Nevada	65,928,000	4.46	8
Ray (Mineral Creek)	Arizona	61,386,000	4.15	9
Central (including Santa Rita)	New Mexico	54,375,000	3.68	10
Ajo	Arizona	38,368,000	2.60	11
Morenci-Metcalf	do	28,735,000	1.94	12
Plumas County	California	22,866,000	1.55	13
Ducktown	Tennessee	18,722,000	1.27	14
Prince William Sound	Alaska	10,916,000	.74	15
Pioneer	Arizona	7,100,000	.48	16
Planet	do	6,558,000	.44	17
Big Bug	do	4,875,000	.33	18
Lordsburg	New Mexico	4,314,000	.29	19
Shasta County	California	3,479,000	.24	20
Tintic	Utah	3,033,000	.21	21
Silver Bell	Arizona	2,513,000	.17	22
Burro Mountain	New Mexico	2,300,000	.16	23
Pima	Arizona	2,175,000	.15	24
Agua Fria (Yavapai)	do	1,823,000	.12	25
Lebanon (Cornwall mine)	Pennsylvania	1,703,000	.12	26
Park City	Utah	1,684,000	.11	27
Foothill belt	California	1,599,000	.11	28
Alder Creek	Idaho	1,453,000	.10	29
San Miguel County	Colorado	1,409,000	.10	30
Eldorado	Idaho	1,279,000	.09	31
Baker County	Oregon	1,277,000	.09	32
Turquoise	Arizona	1,140,000	.08	33
San Juan County	Colorado	1,005,000	.07	34

Copper produced in the principal districts to the end of 1923

District	State	Date production began	Pounds	Per cent	Rank
Butte	Montana	1868	8,403,425,000	25.86	1
Lake Superior	Michigan	1845	7,192,189,000	22.13	2
Bisbee	Arizona	1880	3,029,094,000	9.32	3
Bingham	Utah	1896	2,372,890,000	7.30	4
Globe-Miami	Arizona	1881	2,066,766,000	6.36	5
Morenci-Metcalf	do	1873	1,557,007,000	4.79	6
Jerome	do	1883	1,556,324,000	4.79	7
Ely (Robinson)	Nevada	1908	915,209,000	2.82	8
Central (including Santa Rita)	New Mexico	1800	709,566,000	2.18	9
Ray (Mineral Creek)	Arizona	1911	674,793,000	2.08	10
Shasta County	California	1897	579,131,000	1.78	11
Ducktown	Tennessee	1850	431,516,000	1.33	12
Tintic	Utah	1880	159,677,000	.49	13
Foothill belt	California	1862	156,644,000	.48	14

QUANTITY AND ESTIMATED RECOVERABLE CONTENT OF COPPER-BEARING ORES

For many years the general report on copper in Mineral Resources has contained a section on mine production of copper, including tables showing copper ore produced, copper ore concentrated, smelted, leached, etc. This copper chapter for 1924 is published with detailed ore figures for 1923, and the 1924 ore figures will be published in the chapter for 1925.

The following tables show the quantity and the estimated recoverable content in copper of the ore produced by the mines of the United States in 1920 to 1923. The figures are taken from the mine reports in Mineral Resources. The close agreement between the output as

reported by the smelters and the recoverable quantity as reported by the mines indicates that the estimated recoverable tenor is very close to the actual recovery. The classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are classed not only those which contain 2.5 per cent or more of copper but those which contain less than this percentage if they are valuable chiefly for copper. Under copper-lead and copper-zinc ores are classed complex ores in which copper is a valuable constituent. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for their content of other metals. No attempt has been made to compile tables showing the quantity and recoverable content of this group of copper-bearing ores, but together with old slags and other materials they yielded a total of 38,745,822 pounds of copper in 1923.

Copper produced in the United States in 1923 from ores in which copper constitutes the principal value

State	Copper ore (short tons)	Copper in ore		Gold in ore (fine ounces)	Silver in ore (fine ounces)	Value in gold and silver per ton
		Pounds	Percentage			
Alaska	731,168	85,915,589	5.88	1,627	715,040	$0.85
Arizona	16,331,974	[a] 612,169,974	1.87	106,691	4,269,278	.35
California	546,404	26,725,749	2.45	8,215	341,306	.82
Colorado	4,655	302,685	3.25	2,140	110,552	28.98
Idaho	41,901	2,794,091	3.33	1,517	74,247	2.20
Michigan	5,363,160	138,304,080	1.29	.....	223,997	.46
Montana	4,392,291	[a] 213,554,072	2.43	19,482	7,567,181	1.50
Nevada	2,833,908	66,089,635	1.17	29,551	84,568	.24
New Mexico	2,946,800	61,179,811	1.04	13,851	164,699	.14
North Carolina	157	61,983	19.74	29	74	4.21
Oregon	18,940	1,261,954	3.33	3,182	22,511	4.45
Tennessee	776,477	18,721,932	1.21	320	105,712	.12
Texas	48	3,080	3.21	27	1,764	41.63
Utah	11,519,722	[a] 209,575,614	.91	84,203	867,605	.21
Washington	11,128	855,152	3.84	80	60,805	4.63
Wyoming	584	111,280	9.53	14	254	.86
Total and average	45,519,317	1,437,626,681	1.58	270,929	14,609,593	.39

[a] Exclusive of copper recovered as precipitates from mine waters, as follows: Arizona, 133,055 pounds; Montana 5,781,839 pounds; and Utah, 4,726,339 pounds.

Copper produced in the United States, 1920–1922, from ores in which copper constitutes the principal value

State	1920		1921		1922	
	Copper ore (short tons)	Copper in ore (pounds)	Copper ore (short tons)	Copper in ore (pounds)	Copper ore (short tons)	Copper in ore (pounds)
Alaska	765,018	70,398,442	476,967	56,974,837	581,384	77,967,469
Arizona	14,516,580	557,364,143	5,181,177	184,812,780	10,431,729	[a] 399,014,848
California	346,201	12,489,269	306,134	11,599,540	447,200	21,845,111
Colorado	3,835	383,427	22,195	1,164,248	863	105,864
Idaho	19,259	1,738,541	10,322	1,105,511	32,590	2,572,335
Michigan	5,938,967	154,695,073	3,610,648	86,370,028	4,952,264	121,712,365
Montana	4,002,491	172,581,159	928,461	46,888,812	3,250,213	[a] 152,823,229
Nevada	2,616,237	49,858,120	401,153	10,318,851	629,408	[a] 22,452,852
New Mexico	2,090,711	52,462,145	533,231	13,637,034	1,477,166	31,669,547
Oregon	34,804	2,353,276	2,398	174,300	17,117	1,012,189
Tennessee	589,853	16,727,803	564,457	15,084,294	557,750	14,240,571
Texas	227	14,435	.....	.....	73	4,290
Utah	5,778,373	108,645,375	1,357,857	27,321,481	4,509,380	[a] 90,523,462
Washington	62,814	1,975,604	1,332	246,017	6,086	312,912
Wyoming	.....	.....	50	10,000	24	4,296
	36,765,370	1,201,686,812	13,396,382	455,707,733	26,893,247	936,261,340

[a] Exclusive of copper recovered as precipitates from mine waters, as follows: Arizona, 249,343 pounds; Montana, 10,037,514 pounds; Nevada, 187,196 pounds; Utah, 563,718 pounds.

Copper ores concentrated, smelted, and leached and copper produced from each class of ore in the United States in 1923

State	Ore concentrated			
	Short tons	Concentrates produced (short tons)	Copper in concentrates (pounds)	Percentage of copper
Alaska	686,532	66,680	49,933,280	3.64
Arizona	11,997,060	780,261	299,547,445	1.25
California	516,117	46,666	22,550,703	2.18
Idaho	25,813	2,885	1,257,580	2.44
Michigan	5,363,160	[a] 110,028	[b] 138,304,080	1.29
Montana	4,259,075	1,301,817	203,004,810	2.38
Nevada	2,722,054	283,594	54,943,730	1.01
New Mexico	[c] 2,834,564	138,300	[c] 55,350,789	[c] .98
Oregon	17,980	5,117	1,176,143	3.27
Tennessee	276,465	26,494	6,070,443	1.10
Utah	11,500,803	588,707	208,370,507	.91
Washington	10,131	1,199	674,312	3.33
Total and average	40,209,754	3,351,748	1,041,183,822	1.29

State	Ore leached			Ore smelted		
	Short tons	Copper produced (pounds)	Percentage of copper	Short tons	Copper produced (pounds)	Percentage of copper
Alaska				44,636	35,982,309	40.31
Arizona	1,812,685	38,479,592	1.06	2,522,229	274,142,937	5.43
California				30,287	4,175,046	6.89
Colorado				4,655	302,685	3.25
Idaho				16,088	1,536,511	4.78
Montana				133,216	10,549,262	3.96
Nevada	150	33,913	11.30	111,704	11,111,992	4.97
New Mexico	(c)	(c)	(c)	112,236	5,829,022	2.60
North Carolina				157	61,983	19.74
Oregon				960	85,811	4.47
Tennessee				500,012	12,651,489	1.27
Texas				48	3,080	3.21
Utah				18,919	1,205,107	3.18
Washington				997	180,840	9.07
Wyoming				584	111,280	9.53
Total and average	1,812,835	38,513,505	1.06	3,496,728	357,929,354	5.12

[a] Includes concentrates from sands.
[b] Includes copper from sands.
[c] A quantity of copper ore from New Mexico was leached, but this may not be shown separately and is included under ore concentrated.

Copper ores concentrated and smelted, and copper produced from each class of ore in the United States, 1920–1922

State	Ore concentrated					
	1920		1921		1922	
	Short tons	Copper in concentrates (pounds)	Short tons	Copper in concentrates (pounds)	Short tons	Copper in concentrates (pounds)
Alaska	732,549	50,996,706	448,236	34,585,960	544,212	48,423,640
Arizona	10,185,491	254,663,629	3,632,342	94,634,203	7,617,726	202,095,491
California	342,393	11,644,411	306,024	11,580,827	431,601	19,890,598
Idaho	2,912	105,159	300	8,686	15,776	708,291
Michigan	5,938,967	[a] 154,695,073	3,610,648	[a] 86,370,028	4,952,264	[a] 121,712,365
Montana	3,883,851	163,928,028	881,051	40,447,426	3,132,253	142,465,556
Nevada	2,594,466	48,048,849	392,645	8,824,837	518,523	9,745,733
New Mexico	2,069,292	50,560,611	533,165	13,633,402	1,416,869	28,406,314
Oregon	34,804	2,353,276	2,398	174,300	15,070	813,869
Tennessee			102,517	2,801,200	138,440	2,803,994
Utah	5,502,395	101,848,546	1,113,218	23,813,053	4,471,711	88,098,018
Washington	61,220	1,743,395			4,525	78,284
	31,348,340	840,587,683	11,022,544	316,873,922	23,258,970	665,242,153

[a] Includes copper from sands.

Copper ores concentrated and smelted, and copper produced from each class of ore in the United States, 1920–1922—Continued

State	Ore smelted					
	1920		1921		1922	
	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)
Alaska	32,469	19,401,736	28,731	22,388,877	37,172	29,543,829
Arizona	2,362,250	258,913,975	617,786	69,971,143	1,457,773	169,963,032
California	3,808	844,858	110	18,713	15,599	1,954,513
Colorado	3,835	383,427	22,195	1,164,248	863	105,864
Idaho	16,347	1,633,382	10,022	1,096,825	16,814	1,864,044
Montana	75,730	6,314,734	47,410	6,441,386	117,960	10,357,673
Nevada	21,421	1,802,771	8,508	1,494,014	110,885	12,707,119
New Mexico	21,419	1,901,534	66	3,632	60,297	3,263,233
Oregon					2,047	198,320
Tennessee	589,853	16,727,803	461,940	12,283,094	419,310	11,436,577
Texas	227	14,435			73	4,290
Utah	71,556	4,632,793	37,452	2,766,069	37,669	2,425,444
Washington	1,594	232,209	1,332	246,017	1,561	234,628
Wyoming			50	10,000	24	4,296
	3,200,509	312,803,657	1,235,602	117,884,018	2,278,047	244,062,862

Copper produced from copper-lead and copper-zinc ores in the United States in 1923

State	Copper-lead and copper-zinc ores (short tons)	Copper in ore (pounds)	Percentage of copper
Alaska	59	4,950	4.19
Arizona	229	22,856	4.99
California	83	7,684	4.63
Colorado	380	23,502	3.09
Idaho	52,291	546,343	.52
Montana	106,325	598,152	.28
Nevada	330	21,769	3.30
New Mexico	571	36,169	3.17
Utah	971	90,624	4.67
Washington	942	15,157	.80
Total and average	162,181	1,367,206	.42

Copper derived from ores classed as copper-bearing (copper, copper-lead, and copper-zinc ores) and total production of copper from all sources in the United States in 1923

State	Ore treated (short tons)	Copper recovered (pounds)	Percentage of copper	Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
Alaska	731,227	85,920,539	5.88	85,920,645
Arizona [a]	16,332,203	612,192,830	1.87	618,928,602
California	546,487	26,733,433	2.45	28,317,759
Colorado [b]	5,035	326,187	3.24	4,248,109
Idaho	94,192	3,340,434	1.77	3,979,631
Michigan	5,363,160	138,304,080	1.29	138,304,080
Missouri				202,556
Montana [c]	4,498,616	214,152,224	2.38	224,125,264
Nevada	2,834,238	66,111,404	1.17	67,204,282
New Mexico	2,947,371	61,215,980	1.04	61,356,802
North Carolina	157	61,983	19.74	61,983
Oregon	18,940	1,261,954	3.33	1,283,476
Pennsylvania				1,703,480
Tennessee	776,477	18,721,932	1.21	18,721,932
Texas	48	3,080	3.21	4,257
Utah [c]	11,520,693	209,666,238	.91	222,393,572
Washington	12,070	870,309	3.61	871,999
Wyoming	584	111,280	9.53	111,280
Total and average	45,681,498	1,438,993,887	1.58	1,477,739,709

[a] A large quantity of copper was recovered from ore not classed as copper ore.
[b] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.
[c] Considerable copper was recovered as precipitates from mine waters and from ores not classed as copper ores.

Copper derived from ores classed as copper-bearing (copper, copper-lead, and copper-zinc ores) and total production of copper from all sources in the United States, 1920–1922

State	1920			1921			1922		
	Ore treated	Copper recovered	Copper from all sources, including old slags, smelter cleanings, and precipitates	Ore treated	Copper recovered	Copper from all sources, including old slags, smelter cleanings, and precipitates	Ore treated	Copper recovered	Copper from all sources, including old slags, smelter cleanings, and precipitates
	Short tons	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*
Alaska	765,018	70,298,442	70,435,363	476,967	56,974,837	57,011,597	581,584	77,967,469	77,967,819
Arizona [a]	14,521,688	557,537,803	558,256,302	5,181,318	184,823,028	185,034,194	10,432,164	399,040,128	400,043,128
California	346,201	12,489,269	12,626,272	306,134	11,599,540	11,743,404	447,247	21,849,249	22,539,485
Colorado [b]	4,288	414,292	4,043,734	23,015	1,242,696	4,153,442	1,490	166,163	3,373,454
Georgia	240	5,780	5,780				600	6,000	6,000
Idaho	24,274	1,808,332	2,538,396	19,444	1,231,228	1,688,195	58,733	2,864,430	3,282,842
Michigan	5,938,967	154,695,073	154,695,073	3,610,648	86,370,028	86,370,028	4,952,264	121,712,365	121,712,365
Missouri			1,512,539			137,591			797,400
Montana [c]	4,005,523	172,667,631	177,059,260	928,795	46,913,200	48,098,730	3,271,464	153,027,726	165,754,442
Nevada	2,622,506	50,232,865	50,559,763	402,842	10,346,763	10,961,491	629,510	22,464,135	23,133,091
New Mexico [d]	2,091,005	52,491,434	54,400,691	533,609	13,686,274	14,267,338	1,479,059	31,882,619	31,937,207
Oregon	34,804	2,353,276	2,355,276	2,398	174,300	174,300	17,117	1,012,189	1,046,525
Pennsylvania			405,092			313,302			1,229,926
Tennessee	589,853	16,727,803	16,727,803	564,457	15,084,294	15,084,294	557,750	14,240,571	14,240,571
Texas	227	14,435	14,435				73	4,290	4,290
Utah	5,784,762	109,052,772	116,931,238	1,359,621	27,431,494	30,891,403	4,510,652	90,648,695	97,193,850
Washington	62,904	1,981,061	1,983,134	1,332	246,017	251,544	6,086	312,912	317,203
Wyoming				50	10,000	10,000	24	4,296	4,296
	36,792,260	1,202,870,268	1,224,550,151	13,410,630	456,133,699	466,190,853	26,945,617	937,203,237	964,583,894

[a] A quantity of copper was recovered from old slags and ores not classed as copper ores.
[b] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.
[c] Considerable copper was recovered as precipitates from mine waters and from ores not classed as copper ores.
[d] A quantity of copper was derived from ores classed as lead ores and siliceous ores.

Copper ores produced in the United States, 1917–1923, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1917	7,438,068	4.39	51,044,626	1.19	58,482,694	1.60	0.0058	0.347	$0.49
1918	6,223,674	4.51	53,937,796	1.18	62,289,069	1.51	.0050	.328	.50
1919	3,465,880	4.64	30,769,966	1.35	36,121,622	1.65	.0052	.356	.51
1920	3,200,509	4.89	31,348,340	1.34	36,765,370	1.63	.0047	.331	.46
1921	1,235,602	4.77	11,022,544	1.44	13,396,382	1.70	.0039	.357	.44
1922	2,278,047	5.36	23,258,970	1.43	26,893,247	1.74	.0049	.386	.49
1923	3,496,728	5.12	40,209,754	1.29	45,519,317	1.58	.0060	.321	.39

REVIEW BY COMPANIES AND STATES

SCOPE OF DISCUSSION

This section briefly summarizes the conditions affecting production in the principal copper districts of the country. The tenor of the ore from each district is given, so far as it does not disclose the production of those individual companies whose figures of output have not already been published in their annual reports or elsewhere. More detailed information on the mining operations of the districts is given in the reports on mine production.

Figures of metal output, ore reserves, metal content, and recovery in treatment of individual companies given in this report, unless otherwise stated, are quoted from the published official reports of the companies. The chapter on copper in Mineral Resources for 1915 contains a map showing the location of the copper-producing districts and the metallurgical plants and also a brief discussion of the geologic occurrence of the ores in the several districts.

The American Smelting & Refining Co. reported that its net income available for dividends—after deductions for taxes, bond interest, depreciation, and depletion—was $11,186,991 in 1924 as compared with $8,924,582 in 1923. The earnings on common stock after payment of preferred dividends were $12.60 a share compared with $8.89 in 1923. On February 1, 1925, the dividend payable on the common stock was increased to 6 per cent per annum. Appropriations during the year amounted to $21,385,047 and expenditures to $15,687,076. The expenditures cover, among other things, work on the new copper smelter in Peru which, the company says, will be completed early in 1926; and also on a concentrator at the Charcos mine, San Luis Potosi; on the copper smelter at San Luis Potosi; and the erection of a plant at Baltimore for the manufacture of copper rods and wire.

Operations of the American Smelting & Refining Co., 1914, and 1921-1924

	1914	1921	1922	1923	1924
Production					
Gold ounces	2,540,911	1,780,200	1,744,550	1,871,790	1,868,407
Silver do	77,604,483	75,354,443	84,793,931	94,424,778	92,229,349
Platinum and palladium do	1,664	863	1,165	1,615	1,998
Lead short tons	316,591	207,612	252,898	338,284	412,416
Copper pounds	529,686,000	348,888,000	433,548,000	834,340,000	[a] 522,472
Zinc do	15,748,000	14,628,614	35,040,000	59,813,434	[a] 39,450
Nickel do	356,187	120,080	314,586	452,388	[b]
Tin do		11,915,954	3,766,000	5,166,458	[a] 486
Sulphuric acid do	24,296,000	9,952,000	28,494,000	66,386,000	[a] 35,259
Arsenic do	6,184,000	5,155,522	11,203,052	14,838,789	[a] 10,473
Copper sulphate do	6,798,000	2,237,471	2,274,000	2,060,000	[b]
By-product metals do	1,678,228	3,232,488	12,700,577	13,392,509	20,146,769
Sulphur dioxide do		154,794	1,611		
Operating statistics					
Number of men employed exclusive of Mexico and South America	12,179	7,426	8,994	[a] 25,477	[a] 25,765
Total wages and salaries	$10,212,591	$11,205,547	$12,981,167	[b]	[b]
Average wage per day	$2.33	$4.19	$4.01	[b]	[b]
Charge smelted short tons	4,171,258	2,583,142	3,845,849	5,083,655	5,160,236
Bullion refined do	588,718	357,062	477,890	760,602	898,390
Coal used do	544,619	302,924	300,556	527,985	447,710
Coke used do	447,761	263,384	376,045	480,904	486,459
Fuel oil used barrels	976,528	758,937	1,145,212	1,927,055	2,046,663
Gas used cubic feet	7,430,300	837,012,321	1,684,226,523	3,427,713,457	4,257,998,000
Ore mined short tons	1,266,702	2,205,537	2,738,463	2,600,249	1,551,259
Coal mined do	257,942	360,952	460,144	543,634	501,779
Coke produced do	129,650	100,860	126,968	171,780	206,189

[a] Short tons.
[b] Not given.
[c] Report does not specify "exclusive of Mexico and South America" in 1923 and 1924.

ALASKA

The smelter production of copper from Alaska ores amounted to 77,053,492 pounds in 1924 as compared with 68,648,368 pounds in 1923. In spite of this increase in production the Territory ranked only seventh among the copper-producing States of the country in 1924, whereas in 1923 it ranked fifth; Nevada and New Mexico passed it in 1924. Copper production in New Mexico increased enough to put the State again in seventh place among the copper-producing States in the total production of the country from 1845 through 1924 and to put Alaska again in eighth place. Alaska's total since the beginning of operations is 880,860,023 pounds, represents 2.58 per cent of the total for the country, and is 137,501 pounds less than New Mexico's total.

Prince William Sound.—In 1924 the Beatson mine of the Kennecott Copper Corporation produced 479,915 tons of ore, having an average copper content of 1.70 per cent. This ore was treated at the mill and yielded 29,959 tons of copper concentrates, with a copper content of 23.78 per cent. The recovery for the year was 87.08 per cent, an increase from 85.47 per cent in 1923 and 85.15 per cent in 1922. In 1923 the mine produced 399,628 tons of copper ore, having an average copper content of 1.598 per cent.

Copper River district.—The Bonanza and Jumbo mines of the Kennecott Copper Corporation in 1924 produced 113,531 tons of copper ore, having an average copper content of 12.46 per cent, compared with 171,022 tons, averaging 11.62 per cent, in 1923. Of the total ore produced, 99,240 tons was milled and yielded 15,773

tons of concentrates having an average copper content of 39.2 per cent. At the leaching plant 1,171 tons of copper was obtained from 1,591 tons of precipitates. The total copper recovery from milling and leaching operations was 92.44 per cent as compared with 92.34 per cent in 1923. On August 2 a fire at Kennecott destroyed the power house, but on August 13 a temporary power house was completed, and the interruption of operations was slight. A new permanent power house is now completed.

The company received 13.342 cents a pound for 42,985,532 pounds of copper sold during the year, or 1.554 cents less than the 14.896 cents received in 1923. The company also sold 326,578 ounces of silver during the year but does not report the average price per ounce. The company reports that the average cost of producing copper in 1924 was 9.11 cents a pound delivered to consumer. This cost covered depreciation and taxes but not depletion, and is the cost after sales of silver and miscellaneous earnings were credited. The comparative figure for 1923 was 8.35 cents a pound. A further exchange of Kennecott Copper Corporation stock for Utah Copper Co. stock placed the Kennecott Corporation in control of 88.39 per cent of the Utah stock at the end of 1924. As in 1923, $3 a share was distributed to stockholders in 1924.

The mines of the Mother Lode Coalition Mines Co. in 1924 produced 138,447 tons of copper ore carrying an average of 12.40 per cent of copper and 1.94 ounces of silver a ton. The shipments to the smelter were 9,318 tons of high-grade ore assaying 63.39 per cent copper, and 25,161 tons of concentrates assaying 39.19 per cent copper. From these, 31,417,540 pounds of copper and 245,901 ounces of silver were obtained. In 1923 the Mother Lode mines produced 156,195 tons of ore averaging 11.67 per cent in copper and 1.78 ounces in silver. The shipments to the smelter were 12,055 tons of high-grade ore assaying 61.57 per cent copper and 20,551 tons of concentrates assaying 44.45 per cent.

The cost of producing copper at the Mother Lode mine—copper delivered to consumer—after charging depreciation and taxes and crediting silver was reduced from 7.08 cents a pound in 1923 to 6.87 cents a pound in 1924. The burning of the power plant of the Kennecott Copper Corporation on August 2 interrupted mine operations, which proceeded at a reduced rate until September 27. Enough power was available to keep the output of copper practically normal during August and September, although a larger proportion was produced from high-grade ores.

ARIZONA

The smelter production of copper in Arizona in 1924 amounted to 672,365,115 pounds, or approximately 41 per cent of the total for the country. In 1907 Arizona displaced Montana as the leading copper-producing State and has ranked first in every year since except 1909. In 1909 Montana was first. Arizona also leads in total production of copper, its total of 10,216,985,243 pounds being nearly 30 per cent of the country's total of 34,127,190,671 pounds since 1845. In cumulative production of copper Arizona passed Montana in 1920. The Butte (Mont.) district, however, still holds first place among the copper-producing districts, the production for

Arizona coming from a number of important districts. In Arizona the leading district in total production is the Bisbee, which ranks third among the copper districts of the country.

Bisbee district.—The copper production for the Bisbee district for several years is given below. Although the district leads the copper districts of Arizona in total production, the Globe-Miami district has for a number of years produced considerably more copper than the Bisbee district.

Copper produced in Bisbee district, Ariz., 1918–1924, in pounds

1918	160, 456, 000	1922	79, 591, 000
1919	122, 311, 000	1923	123, 884, 000
1920	118, 448, 000	1924	140, 630, 000
1921	37, 249, 000		

The operations of the Copper Queen branch of the Phelps Dodge Corporation are the largest in the Bisbee district. In 1924 the corporation sold, including copper received from other sources, 277,881,973 pounds of copper, of which 203,379,744 pounds was for domestic trade and 74,502,229 pounds for foreign trade. Of this amount 195,055,594 pounds was from the corporation's mines, 1,789,093 pounds was copper from ores purchased, and 81,037,286 pounds was sold on commission. Sales to foreign trade increased from 22.6 per cent of the total to 26.8 per cent.

During the year the underground production of copper at the limestone mines decreased 3,600,000 pounds owing to less ore from leasers, as the company's production showed a small increase. A total of 2,319,529 solid yards of ore and waste was removed from Sacramento Hill in 1924. The tonnage of ore produced was at a ratio of 1 ton for each 2.4 tons of waste and material to be leached combined. The company estimated that in 1925 the ratio would be 1 ton of production for each ton of waste. Of the ore produced 1,455,474 tons was sent to the mill, 35,696 tons to the stock pile, and 24,039 tons direct to the smelter.

The concentrator received 1,488,386 tons of ore during the year and ran steadily. It produced 329,244 tons of concentrates having a copper content of 6.48 per cent and showing a ratio of concentration of 4.49 into 1. The tailings assayed 0.19 per cent in copper, of which 0.13 per cent was in the form of sulphide.

Three months' operation of the 6-tank precipitation plant completed in September, seems to indicate that the low grade ores from Sacramento Hill can be treated successfully by heap leaching.

Metals produced by Copper Queen Consolidated Mining Co., 1918–1924

Year	Ore	Copper	Silver	Gold	Lead	Zinc
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Pounds*	*Pounds*
1918	771, 063	90, 988, 156	558, 433	16, 409	1, 234, 497	----------
1919	606, 386	68, 614, 002	492, 326	10, 813	9, 372	----------
1920	832, 172	71, 443, 396	486, 698	8, 846	243, 836	----------
1921	515, 632	30, 610, 173	495, 179	4, 650	4, 916, 418	----------
1922	389, 367	47, 962, 123	1, 132, 304	11, 972	8, 560, 525	247, 793
1923	1, 189, 570	87, 935, 334	935, 729	19, 151	6, 307, 412	610, 709
1924	2, 022, 196	109, 117, 018	906, 521	29, 850	6, 094, 613	----------

Metals produced by Copper Queen branch of Phelps Dodge Corporation, 1924

	Ore, dry weight	Gold	Silver	Copper	Lead	Zinc
Underground:						
Company—	*Short tons*	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*
Copper ore	393,266	6,924	248,376	50,201,937	----------	----------
Silver ore to Douglas	483	45	5,438	1,943	----------	----------
Lease—Copper ore	83,582	11,201	228,103	8,267,570	----------	----------
	477,331	18,170	481,917	58,471,450	----------	----------
Company—Lead ore	9,168	659	124,292	30,867	1,674,738	----------
Lease—Lead ore	19,803	500	73,643	568,916	4,419,875	----------
	28,971	1,159	197,935	599,783	6,094,613	----------
	506,302	19,329	679,852	59,071,233	6,094,613	----------
Sacramento Hill:						
Company—						
Smelting ore	24,040	18	5,465	2,209,894	----------	----------
Milling ore	1,491,170	10,503	221,180	47,264,030	----------	----------
	1,515,210	10,521	226,645	49,473,924	----------	----------
Precipitates:						
From leach heap	134	----------	2	198,612	----------	----------
From underground	550	----------	22	373,249	----------	----------
	684	----------	24	571,861	----------	----------
Total production	2,022,196	29,850	906,521	109,117,018	6,094,613	----------

During the year the Calumet & Arizona Mining Co. sold 46,703,372 pounds of copper, for which it received an average of 13.2697 cents a pound. The recovery of precious metals from Calumet & Arizona ore averaged $55.46 per ton of refined copper. At the Junction mine the completion of the 2,200-foot pump station has made possible the development of a large mineralized area containing high-grade ore and pyrite in the western part of the Erie Cattle, approximately 600 feet from the Junction shaft. The extent of this ore has not been determined, but it has already been developed 135 feet north and south, and 42 feet east and west. In the vicinity of the Campbell shaft on the 1,800-foot level good ore has been found in several places and one lenticular body of ore developed for a length of 140 feet. An important feature is that this ore is 1,500 feet south of any ore previously found in the Junction mine. During the year the company did 59,325.5 feet of development work, compared with 49,103.5 feet in 1923. The new fine-crushing plant, sampling plant, and Cottrell treaters at the roasters were completed during the year. The ore shipped to the Calumet & Arizona smelter at Douglas in 1924 averaged 4.83 per cent of copper, compared with 4.62 per cent in 1923. The smelter treated 593,324 dry tons of ore and concentrates during the year, an average of 1,621 tons a day. Of this 410,805 tons was Calumet & Arizona ore, 55,692 tons was concentrates from the new New Cornelia Copper Co.'s mill and 126,827 tons was custom ore. The blister copper produced amounted to 79,025,610 pounds.

The sulphuric acid plant produced 19,665.42 tons of 60° acid, of which 17,921.26 tons was shipped, 15,941.22 tons to the New Cornelia Copper Co. and 1,980.04 tons to outside customers.

Metals produced by Calumet & Arizona Mining Co., 1918–1924

Year	Refined copper produced (domestic)	Gold	Silver	Dividends
	Pounds	*Ounces*	*Ounces*	
1918	50, 909, 373	31, 308	906, 210	$5, 140, 062
1919	44, 991, 107	28, 530	995, 366	1, 927, 563
1920	42, 430, 847	32, 520	932, 489	2, 570, 084
1921	17, 855, 613	12, 365	419, 647	1, 285, 043
1922	30, 830, 615	23, 349	642, 174	1, 285, 047
1923	42, 166, 930	35, 693	824, 768	2, 248, 849
1924	41, 582, 030	31, 934	813, 791	1, 285, 063

The Shattuck Arizona Copper Co. mined less copper in 1924 than in 1923, owing to the low price prevailing for copper. The recoverable copper content of copper ores was 6.44 per cent, practically the same as in 1923. The recoverable gold and silver in the copper ores decreased, however, and, together with a decrease in the price received for silver, caused a decline of $2 a ton of copper ore for gold and silver credit, consequently causing an increase in the net cost a pound of copper produced. The total operating cost of copper delivered in New York, after credits, was 10.06 cents a pound, including depreciation but not depletion. Development work during the year amounted to 1 foot for each 4.12 tons of copper ore mined, making an exploration and development cost of $2.13 a wet ton of copper ore mined. Copper sales by the Shattuck Co. totaled only 954,000 pounds at an average price of 14.273 cents a pound, leaving 4,899,394 pounds of unsold copper on hand.

Metallic production of the Shattuck Arizona Copper Co. in 1924

Copper ore mined	wet short tons	21, 276. 67
Copper ore shipped	do	21, 601. 67
Copper ore treated	do	21, 549. 67
Average moisture in copper ore	per cent	5. 26
Lead ores mined	wet short tons	42, 610. 88
Lead ores shipped	do	42, 545. 88
Lead ores treated	do	43, 157. 33
Average moisture in lead ores	per cent	4. 29
Copper recovered	pounds	2, 630, 185
Copper recovered per dry ton	do	128. 82
Gold from copper ores	ounces	754
Silver from copper ores	do	72, 671
Lead recovered	pounds	5, 244, 526
Gold from lead ores	ounces	3, 518
Silver from lead ores	do	315, 776
Gross copper operating cost	cents per pound	12. 621
Operating credits (copper)	do	2. 564
Net copper operating cost	do	10. 057
Average price received for copper	do	14. 273

Metals produced by Shattuck Arizona Copper Co., 1918–1924

Year	Copper	Silver (from copper ores)	Gold (from copper ores)	Recoverable lead content	Recoverable copper content	Dividends
	Pounds	*Ounces*	*Ounces*	*Pounds*	*Per cent*	
1918	9, 081, 959	161, 230	1, 220	2, 420, 690	4. 83	$437, 500
1919	2, 111, 841	89, 724	300	4, 432, 655	4. 74	[a] 262, 500
1920	2, 374, 148	73, 718	575	8, 254, 603	6. 19	----------
1921 [b]	287, 928	12, 093	29	----------	7. 94	----------
1922	----------	----------	----------	----------	----------	----------
1923	3, 223, 209	157, 124	1, 349	1, 590, 682	6. 42	----------
1924	2, 630, 185	72, 671	754	5, 244, 526	6. 44	----------

[a] Capital distribution through 1924 to the amount of $1,487,500.
[b] Result of development work only. No productive operations carried on.

Globe-Miami district.—The production of the Globe-Miami district in 1924 and several preceding years is given below.

Copper produced in Globe-Miami district, Arizona, 1917–1924, in pounds

1917	169, 490, 000	1921	76, 488, 000
1918	201, 806, 000	1922	170, 035, 000
1919	171, 106, 000	1923	198, 426, 000
1920	176, 215, 000	1924	190, 452, 000

Ore production of the Old Dominion Co. increased in 1924 because of the larger output of concentrating ore; the output of smelting and converting ores decreased. The average copper content of the ore produced declined from 4.95 per cent in 1923 to 4.62 per cent in 1924. The company says that the average grade of concentrating ore extracted was lower than the average grade of the sulphide reserves at the beginning of 1925, and that the average grade of smelting ore mined was somewhat higher than the average grade of the oxide reserves, and some of the lower-grade material was left there, because the ore was sorted in the stopes. Development work during the year increased the reserves of all classes of ore by 125,894 tons. The company says that the Old Dominion property has produced 453,000,000 pounds of copper since 1907 and has paid $13,831,172 in dividends since that year. Since the introduction of selective flotation at the concentrator of the Old Dominion Co., ores that formerly could be treated only in the smelter have been treated more profitably at the concentrator. As the production of oxidized ores was too small to warrant continuance of smelting, the smelter was closed down November 30. The company has a contract with the International Smelting Co. for the treatment of its entire product.

Ore produced by Old Dominion Co., 1924

	Short tons	Percentage of copper
Smelting ore	55, 126	8. 05
Concentrating ore	236, 536	3. 81
Converting ore	3, 337	2. 95
	294, 999	4. 62

Metals produced by Old Dominion Co., 1918–1924[a]

Year	Ore	Copper	Gold	Silver	Average grade of ore in copper	Dividends
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Per cent*	
1918	230, 451	33, 378, 158	5, 071	184, 982	4. 52	$1, 188, 284
1919	253, 686	28, 166, 396	5, 756	137, 071	4. 28	
1920	249, 111	22, 854, 452	3, 484	181, 010	4. 79	
1921	61, 753	7, 389, 648	1, 187	71, 155	5. 31	
1922	202, 954	18, 573, 289	3, 317	122, 095	5. 14	
1923	289, 695	26, 764, 801	5, 137	190, 033	4. 95	
1924	294, 999	25, 400, 670	5, 531	155, 814	4. 62	

[a] Includes custom metals produced.

In 1924 the Miami Copper Co. produced 60,475,547 pounds of copper. Because of the need of beginning to mine and treat low-grade sulphide ores, the company is enlarging its plant to handle 10,000 tons of ore a day, instead of 6,800 tons. The reserves of so-called high-grade sulphide ore had been reduced to 4,034,505 tons at the beginning of 1925. Of this tonnage some is associated with mixed sulphide and oxide ore and some with the low-grade sulphide ore. About 1,500,000 tons of it lies below the present haulage levels, and its mining at present would menace the mining of the low-grade ore body. In consequence, slightly less than 1,500,000 tons of this grade was available for mining at the beginning of 1925. The company estimates that with the increased milling capacity the production of copper will be 50,000,000 pounds a year. An economical method of treating the mixed sulphide and oxide ore has not been found. The cost of producing copper in 1924 was 11.228 cents a pound, which includes all charges for repairs, renewals, and upkeep, but are exclusive of a direct charge for depreciation and charges for depletion. Four quarterly dividends totaling $2 a share were paid in 1924.

Copper produced by Miami Copper Co., 1918–1924

Year	Ore	Copper content	Mill extraction	Refined copper	Dividends
	Short tons	*Per cent*	*Per cent*	*Pounds*	
1918	2,132,941	2.026	71.15	58,407,563	$3,362,013
1919	1,698,446	2.04	82.38	54,221,638	1,867,785
1920	1,801,958	1.968	82.48	55,581,328	1,494,228
1921	1,868,757	1.758	85.37	53,311,941	1,494,228
1922	2,183,020	1.883	86.36	67,454,447	1,494,228
1923	2,380,155	1.697	83.98	64,448,345	1,494,228
1924	2,444,079	1.624	80.17	60,475,547	1,494,228

Milling operations of Miami Copper Co., 1924

Ore milled	short tons	2,444,079
Copper in ore	per cent	1.624
Concentrates produced	short tons	80,516
Copper in concentrates	per cent	39.532
	pounds	63,658,471
Copper recovered per ton of ore	do	26.046
Mill extraction	per cent	80.17

Cost of copper in concentrates f. o. b. cars at Miami, Ariz., 1924

	Per ton of ore	Per pound of copper
Mining	$1.12948	$0.04565
Milling	.63679	.02573
General	.27027	.01092
	2.03654	.08230

Ore reserves of Miami Copper Co., January 1, 1925

	Short tons	Percentage of copper
High-grade sulphide ore	4,034,505	2.08
Mixed sulphide and oxide ore	6,000,000	2.00
Low-grade sulphide ore	36,000,000	1.06
	46,034,505	

The Inspiration Consolidated Copper Co. in 1924 produced 90,709,878 pounds of fine copper, or 7,559,156 pounds a month. The copper content of the ore mined averaged 1.135 per cent, which is lower than the average. According to the company, this decline is largely due to the delay in placing in commission the new Porphyry shaft, through which the ore from the Live Oak section is hoisted. This shaft and its surface equipment was put in operation on November 25. Production from the Live Oak section is steadily increasing. The 5,504,565.8 dry tons of ore mined in 1924 came from the following sections: Inspiration section, 5,154,588 tons, averaging 1.129 per cent copper; Warrior section, 9,603.8 tons, averaging 5.766 per cent copper; and Live Oak section, 340,374 tons, averaging 1.213 per cent copper. Of this total 5,478,985.7 tons was shipped to the concentrator and 25,580.1 tons to the smelter. The ore mined per man shift for all labor chargeable to mining ore increased from 16 tons in 1923 to 17.5 tons in 1924. The company has spent six years in experimental work on processes for the treatment of mixed oxide and sulphide copper ores, and in cooperation with the Bureau of Mines has devised a leaching process using ferric sulphate and sulphuric acid. Operation of a pilot unit from January 15 to December 15, 1923, gave satisfactory and consistent results. A plant designed to treat 7,500 tons of ore a day by the ferric sulphate-sulphuric acid process has been authorized and is expected to be in operation by December, 1926. The cost of fine copper produced during 1924, including depreciation but excluding depletion and Federal taxes, amounted to 11.0251 cents a pound of copper.

Mill statistics, Inspiration Consolidated Copper Co., 1924

Total ore milled	dry tons	5,463,359
Ore milled per day	do	15,134
Average number of sections running		15.8
Average rate per section	tons	960
Screen analysis of feed (on 48 mesh)	per cent	5.9
Assay mill feed	per cent of copper	1.135
Copper in feed, oxidized	per cent	.243
Copper assay of general tailings	do	.306
Copper in general tailings, oxidized	do	.238
Copper in general concentrates, smelter assay	do	27.565
Copper in flotation concentrates	do	32.55
Copper in table concentrates	do	10.40
Moisture in general concentrates	do	13.86
Ratio of concentration		32.6
Recovery of copper (calculated from smelter assays):		
Assays only	per cent	73.86
Assays and weights of concentrates and ore	do	74.53
Assays and weights of concentrates and tailings	do	74.03
Assays and weights of ore and tailings	do	73.86
Recovery of copper sulphides	do	92.62
Water used per ton of ore	tons	1.772
Power used per ton of ore milled:		
Coarse crushing	kilowatt-hours	.45
Fine grinding and concentrating	do	9.90
Blowers for flotation air	do	1.98
Filtering and reclaiming water	do	.73
Lighting	do	.10
		13.16
Steel balls consumed per ton of ore milled	pounds	1.54

Flotation oil consumed per ton of ore milled (to Nov. 15):		
Coal tar	pounds	.75
Other oils	do	.10
		.85
Flotation material consumed per ton of ore milled (Nov. 16 to Dec. 31):		
Flotation reagent	pounds	.29
Pine oil	do	.08
Lime	do	1.12
		1.49

Copper produced by the Inspiration Copper Co., 1924

	Ore treated (tons)	Copper produced (pounds)
Inspiration concentrating ore	5,135,856	83,633,200
Live Oak concentrating ore	327,503	5,746,380
Inspiration ore to smelter	14,070	259,667
Warrior ore to smelter	9,604	1,052,213
Live Oak ore to smelter	906	18,418
	5,487,939	90,709,878
From ore treated in experimental leaching plant in 1923, returnable in 1924		123,049
		90,832,927

The mine and mill of the Iron Cap Copper Co. were active throughout the year, but operations were unsatisfactory until November, when the price for copper advanced. The average price obtained for copper was 13.024 cents a pound in 1924 compared with 14.446 cents a pound in 1923.

Metallic production of the Iron Cap Copper Co., 1919–1924

	1919	1920	1921	1922	1923	1924
Ore (dry weight) short tons	64,540	91,326	4,424	69,675	83,931	83,312
Silver recovered ounces	104,458	113,323	4,002	72,005	75,982	85,680
Copper recovered pounds	7,156,270	8,235,670	385,548	5,829,122	6,134,162	5,383,059
Average price received:						
Per ounce of silver	$1.104	$1.083	$1.015	$0.9952	$0.77826	.6725
Per pound of copper	.18918	.17444	.12580	.13425	.14446	.13024

Result of mill operation of the Iron Cap Copper Co., 1924

Ore milled (dry)	short tons	76,340
Average assay of feed	per cent of copper	3.53
	ounces of silver per ton	.95
Copper contained in ore	pounds	5,384,246
Silver contained in ore	ounces	72,923
Concentrates produced (dry)	short tons	11,086
Average assay of concentrates	per cent of copper	22.26
	ounce of silver per ton	5.55
Copper contained in concentrates	pounds	4,934,904
Silver contained in concentrates	ounces	61,525
Tailings rejected (dry)	short tons	65,253
Average assays of tailings	per cent of copper	.344
	ounce of silver per ton	.175
Copper contained in tailings	pounds	449,342
Silver contained in tailings	ounces	11,398
Recovery of copper	per cent	91.65
Recovery of silver	do	84.37
Operating cost per dry short ton		$1.60

The Copper Hill mine of the Arizona Commercial Mining Co. was continuously active in 1924. The ore was concentrated at the Old Dominion plant and smelted at the International smelter. More ore was mined than in 1923, but the copper content was smaller. The reserves of ore are about the same as at the end of 1923, approximating four years' supply at the present rate of production. Two dividends of 50 cents each were paid by the company on January 31 and July 31.

Copper, gold, and silver produced by the Arizona Commercial Mining Co., 1919–1924

Year	Refined copper	Gold	Silver
	Pounds	*Ounces*	*Ounces*
1919	7,280,861	1,310	16,918
1920	7,913,836	1,722	31,028
1921	572,616	163	3,001
1922	6,220,923	1,585	27,532
1923	8,115,212	2,143	37,826
1924	7,760,931	1,883	32,634

The Superior & Boston Copper Co., during the fiscal year ended September 30, 1924, shipped to the smelters 21,304 dry tons of ore, averaging 3.66 per cent of copper and 13.95 ounces of silver, which contained 1,560,599 pounds of copper and 297,066 ounces of silver. Less development work was done during the year because of the decreased value of the shipments and an attempt on the part of the company to keep expenses within receipts. The ratio maintained, however, of 1 foot of development drifts or crosscuts for 4.7 tons of ore mined, is, according to the company, relatively high for the district.

Morenci-Metcalf district.—The production of the Morenci-Metcalf district for several years, including 1924, is shown below.

Copper produced in Morenci-Metcalf district, 1917–1924, in pounds

1917	53,000,000	1921	11,420,000
1918	71,867,000	1922	14,175,900
1919	44,868,000	1923	28,735,000
1920	35,746,000	1924	41,047,000

Production at the Morenci branch of the Phelps Dodge Corporation averaged slightly over 2,000 tons a day at the first of 1924 but increased after the remodeling of the mill was completed and at the end of the year almost equaled the capacity of the mill. The company believes that with the addition of some minor improvements and processes this branch should eventually be one of the lowest cost producers of the corporation. Good progress is reported in metallurgical improvements and in reducing costs at the smelting plant.

Metal production of the Morenci branch of the Phelps Dodge Corporation in 1924

	Ore, dry weight	Copper contained	Silver	Gold
Mine:	*Short tons*	*Pounds*	*Ounces*	*Ounces*
Company ore	1,067,730	49,721,277	(a)	(a)
Lease ore	20,360	4,140,442	(a)	(a)
Miscellaneous shipments	1,248	379,952	(a)	(a)
	1,089,338	54,241,671	(a)	(a)
Concentrator, concentrates	87,085	36,198,864	(a)	(a)
Smelter, blister copper		41,080,484	84,034	2,759

(a) Not shown.

The production of the Arizona Copper Co. from 1916 until it was taken over by the Phelps Dodge Corporation is shown below:

Copper produced by Arizona Copper Co., 1916—1921

Year ending Sept. 30—	Ore treated	Copper produced	Average yield
	Short tons	*Pounds*	*Per cent*
1916	905,486	34,100,000	1.803
1917	1,178,087	42,482,000	1.830
1918	1,095,568	40,442,000	1.754
1919	1,147,659	36,474,000	1.611
1920	1,046,331	35,692,000	1.642
1921 [a]	573,397	18,550,000	1.701

[a] Figures are for 8 months ended May 31, 1921, when plant was shut down.

Yavapai County.—The production of copper in Yavapai County, mostly from the Jerome district, in 1924 and in several preceding years is given in the table below. The chief producers of the Jerome district are the United Verde Copper Co. and the United Verde Extension Mining Co.

Copper produced in Yavapai County, Ariz., 1917–1924, in pounds

1917	159,612,146	1921	26,576,298
1918	148,882,695	1922	76,607,502
1919	80,227,549	1923	147,718,492
1920	114,937,080	1924	143,348,230

The United Verde Extension mine and smelter operated without interruption in 1924. There was 187,634 dry tons of ore produced, assaying 12.23 per cent of copper, 0.048 ounce of gold, and 1.93 ounces of silver. The company sold 45,462,053 pounds of copper during the year and had 10,261,618 pounds of copper on hand on January 1, 1925, compared with 11,444,724 pounds at the beginning of 1924. The reserves of ore developed above the 1,600-foot level were estimated to be 946,319 tons, averaging 10.53 per cent of copper, 0.034 ounce of gold, and 2 ounces of silver, somewhat higher in copper and gold than the estimated reserves at the end of 1923. The average cost per pound of copper produced, shown in detail below, was 7.49 cents a pound exclusive of depreciation, reserve to return capital (depletion), and taxes, compared with 7.27 cents a pound in 1923.

Cost [2] of producing copper by United Verde Extension Mining Co. in 1924

Mining	cents per pound	2.84
Smelting	do	2.61
Freight on ore	do	.08
Freight on bullion, refining, selling	do	1.87
Other expenses	do	.09

Copper produced by the United Verde Extension Mining Co., 1918–1924

Year	Ore treated	Copper produced	Silver	Gold
	Short tons	*Pounds*	*Ounces*	*Ounces*
1918	133,535	55,491,077	503,739	3,046
1919	93,325	28,860,615	272,855	3,169
1920	161,617	41,942,700	359,370	5,530
1921	53,643	12,498,005	112,864	2,328
1922	136,980	31,640,714	238,764	5,788
1923	172,629	41,855,959	257,602	8,992
1924	185,858	44,278,947	(a)	(a)

[a] Figures not available.

[2] Exclusive of depreciation, reserve to return capital (depletion), and taxes.

The mining methods of the United Verde Copper Co. are described in the Engineering and Mining Journal-Press, February 28 and March 7, 1925, pages 357 to 360 and 397 to 401.

Ray or Mineral Creek district.—At the Ray mines of the Ray Consolidated Copper Co. the net production of copper from all sources, after allowing for smelter deductions, was 67,017,981 pounds. Development work during the year was confined chiefly to opening ground to keep pace with tonnage requirements. Ore reserves on December 31, 1924, were not recalculated, but deducting the tonnage mined during the year from the reserves reported at the end of 1923 gave 75,845,678 tons. Remodeling of the fine grinding and gravity concentration departments of the Hayden mill continued in 1924, and at the end of the year seven sections had been practically completed. The reconstructed sections can handle 1,500 tons a day, 250 tons a day more than formerly, and are more economical and efficient. These alterations have decreased costs and have increased the mill recovery which was well over 80 per cent at the end of the year compared with an average of 78.27 per cent for the entire year. As the flotation plant is too small to treat the more finely ground and higher grade flotation feed from the remodeled mill sections it has been decided to move the flotation equipment into the mill building, where discarded vanners used to be, and to add the necessary flotation units. In 1924, there were 206,360 tons of concentrates, averaging 16.731 per cent of copper, produced. The recovery of copper occurring as sulphides was 85.69 per cent and as carbonates and other oxidized minerals 33.10 per cent. The average cost of copper produced in marketable form for both the Ray and Chino mines was 11.30 cents a pound. This figure covers all operating, administrative, and general expenses, taxes, and all other costs or charges except depreciation, and also includes credits amounting to 0.22 cent a pound for precious metals and income from miscellaneous sources immediately pertaining to operations.

The following table shows the milling performances for several years:

Copper produced by Ray Consolidated Mining Co., 1918–1924

Year	Ore milled	Copper content	Mill recovery	Refined copper	Cost per pound [a]	Dividends and capital distributions
	Short tons	*Per cent*	*Per cent*	*Pounds*	*Cents*	
1918	3,411,000	1.613	74.92	83,599,160	17.695	$5,125,831
1919	1,621,600	1.814	79.45	46,011,371	15.62	3,154,358
1920	1,706,928	1.720	81.98	47,062,030	16.144	1,577,179
1921	406,172	1.646	77.82	10,110,131	16.41	----------
1922	1,178,350	1.587	76.66	27,953,408	[b] 12.41	----------
1923	2,689,800	1.571	74.87	61,385,205	[b] 12.03	----------
1924	2,896,700	1.523	78.27	67,017,981	[b] 11.30	----------

[a] Does not include amount received for gold and silver or miscellaneous income.

[b] Includes amount received for gold and silver and miscellaneous income but not charges for depreciation. Comparative value for 1921 was 16.25 cents. In 1924 the costs for the Ray and Chino mines were computed together.

Ajo district.—The New Cornelia Copper Co. produced 63,884,293 pounds of copper in 1924, 162,067.60 ounces of silver, and 10,675.48 ounces of gold, a large increase over 1923. This increase is attributable to the new flotation mill. The first unit of the plant was started

on January 8, and all five units were in operation March 29. The anticipated 5,000-ton capacity was surpassed during the year, especially in November and December, when the average daily output was 6,417 tons, or 28 per cent in excess of the rating. Through the operation of the new plant the rate of operation at the leaching plant was reduced, thus conserving the carbonate ore reserves of the mine and postponing the building of an extension to the flotation concentrator. At the leaching and concentrating plants 3,049,944 wet tons of ore were treated, of which 1,220,027 tons were carbonate ore, averaging 1.394 per cent copper, and 1,829,917 tons were sulphide ore, averaging 1.606 per cent copper. It is estimated that the reserves of carbonate ore containing over 0.8 per cent copper and averaging 1.27 per cent copper amounted to 4,071,099 tons, and that the reserves of sulphide ore containing over 0.8 per cent of copper and averaging 1.41 per cent of copper amounted to 56,611,491 tons. The company estimates that the two plants operating at capacity can produce 8,000,000 pounds of copper a month from the reserves of ore of average grade.

Copper produced by the New Cornelia Copper Co., 1921–1924, in pounds

	1921	1922	1923	1924
Electrolytic copper	19,993,758	26,408,610	36,063,832	22,746,882
Cement copper	169,035	140,732	2,303,886	1,729,479
Copper in ore shipped	35,589	63,461		
Copper from concentrates				39,407,932
	20,198,382	26,612,803	38,367,718	63,884,293

Pioneer district.—At the new smelter of the Magma Copper Co., the first copper bullion was poured on March 29, 1924. In April, the first month of full operation, the output was 1,981,614 pounds of copper, and during the calendar year 1924, 23,301,511 pounds of copper, 533,204.05 ounces of silver, and 7,588.52 ounces of gold were produced. Shipments to the Hayden smelter of the American Smelting & Refining Co. stopped on December 25, 1923, and from then until the opening of the Magma plant the concentrates and smelting ore were stacked at the smelter. The costs for the first year's operations at the new plant were less than estimated. No special effort was made in 1924 to develop larger ore reserves. During the year 222,307 tons of ore, averaging 6.115 per cent of copper, 2.797 ounces of silver, and 0.0326 ounce of gold, was mined.

Two articles [3] dealing with the Magma Co. have recently appeared in the Engineering and Mining Journal-Press.

CALIFORNIA

The smelter production of copper in California increased from 27,042,835 pounds, representing 1.88 per cent of the United States total in 1923, to 49,433,716 pounds, 3.03 per cent of the total in 1924. This tonnage brings the total output in California, from the beginning

[3] Ruth, H. A., "The new Magma smelter," Eng. and Min. Jour.-Press, vol. 118, Nov. 1, 1924, pp. 685–693. Browning, W. C., and Snow, F. W., "Geology and operations of the Magma mines," Eng. and Min. Jour.-Press, vol. 119, Jan. 31, 1925, pp. 197–201.

of operations through 1924, to 893,102,034 pounds of copper, representing 2.62 per cent of the country's total and placing California sixth among the copper-producing States. In 1924 California ranked eighth. The Shasta district has been by far the most important producing district in the State, the Foothill belt ranking next. However, since 1917 the Plumas district has produced more copper than the Foothill district and since 1918 has produced more than Shasta County.

Shasta district.—The smelter of the United States Smelting, Refining & Mining Co. ran on a two-furnace basis throughout the year and smelted 196,045 tons of sulphide ore. Some new ore was developed, but the company expected that all the known commercial ore would be extracted in 1925 and the plant shut down.

On account of the unsatisfactory price of copper the smelter of the Mountain Copper Co. remained closed throughout the year.

Foothill district.—The Foothill district produced 4,854,931 pounds of copper in 1924, compared with 1,598,726 pounds in 1923. None was produced in this district in 1921 and 1922.

Plumas district.—In 1924 Plumas County produced 25,557,676 pounds of copper, 369,506 ounces of silver, and 13,427.50 ounces of gold. The Engels Copper Mining Co. produced 12,870,111 pounds of copper, a decrease of 1,580,132 pounds from the production in 1923, 150,427 ounces of silver, and 2,593 ounces of gold during the year. Production was curtailed about 25 per cent pending the opening of the ore on the new levels of the Engels mine and an improvement in the price of copper. Since the beginning of 1925, under better market conditions, the production has increased to about 1,250,000 pounds of copper a month, compared with 1,072,508 pounds a month in 1924. The cost of producing copper was 11.30 cents a pound, exclusive of depreciation and depletion charges, and 13.10 cents a pound, including these charges. The average price received for copper during the year was 13.06 cents a pound, compared with 14.41 cents in 1923. The Superior mill treated 350,445 dry tons of ore from the Engels and Superior mines. This ore averaged 2.0538 per cent copper and yielded 46,146,644 pounds of dry concentrate, averaging 27.89 per cent copper. The percentage extraction of copper at the mill increased from 88.737 in the preceding year to 89.406 in 1924.

Cost of producing copper by Engels Copper Mining Co., 1924

		Total	Per pound of copper
			Cents
Ore on cars at Engels		$994,702.00	7.7288
Freight and smelting charges	$604,235.73		
Credit value of gold and silver recovered	144,951.04		
		459,284.69	3.5686
Operating and marketing cost		1,453,986.69	11.2974
Depreciation costs		151,581.87	1.8040
Development amortization		80,602.35	
		1,686,170.91	13.1014

Operations at Superior mill, 1924

Ore milled	short tons	350, 445
Average heads	per cent	2. 0538
Average tails	do	. 2304
Actual extraction	do	89. 406
Concentrates produced	pounds	46, 146, 644
Average content of concentrates	per cent	27. 89
Copper produced	pounds	12, 870, 111
Silver produced	ounces	150, 433. 6779
Gold produced	do	2, 593. 4526

Ore reserves of Engels and Superior mines, December 31, 1924, in short tons •

Mine	Blocked ore		Probable ore	Total
	In place	Broken in stopes		
Engels	1, 115, 254	185, 588	635, 526	1, 936, 368
Superior	424, 575	148, 204	340, 250	913, 029
	1, 539, 829	333, 792	975, 776	2, 849, 397

• Estimate includes ore in pillars. Does not include reserves containing less than 2 per cent copper.

The company states that the above estimate of ore reserves is based on a technical interpretation of the conditions as found in the mines December 31, 1924, and should not be construed to mean that it includes all ore, both probable and possible, that is contained in the mines.

The Walker Mining Co., a subsidiary of the Anaconda Copper Mining Co., worked its mine throughout the year and broke 251,492 tons of ore. The new concentrator which began operation in November, 1923, fully met expectations, with an average recovery of 95.84 per cent. The 205,903.40 tons of ore treated averaged 3.268 per cent copper and gave 25,314.64 tons of concentrates averaging 24.529 per cent copper. The 25,747.35 tons of concentrates delivered to the smelter contained 12,659,429 pounds of copper, 217,764.28 ounces of silver, and 8,216.408 ounces of gold.

COLORADO

The production of blister copper from Colorado ores and concentrates in 1924 amounted to 4,158,612 pounds, compared with 4,343,418 pounds in 1923. This represented 0.25 per cent of the total output of the country and gave Colorado tenth rank among the copper-producing States. In the country's total production since 1845 Colorado also ranks tenth, with a production of 302,743,132 pounds, or 0.89 per cent of the total for the country. Colorado's copper output is derived mainly from the treatment of mixed ores in which copper is a minor constituent. They include lead-silver ores and pyritic ores rich in gold and silver. No important district in the State now yields ore mainly valuable for copper.

IDAHO

From the beginning of operations through 1924 Idaho ores have yielded a total smelter output of 124,768,157 pounds of copper. This output represents 0.36 per cent of the country's total and places Idaho eleventh among the copper-producing States. In 1924 Idaho's output was 3,148,519 pounds of copper, or 0.19 per cent of the total

for the country, compared with 3,664,079 pounds, or 0.26 per cent of the total, in 1923. The copper comes mainly from the Alder Creek district.

MICHIGAN

Lake Superior district.—The production of copper in Michigan during 1924 amounted to 145,333,227 pounds and represented 8.89 per cent of the total for the country. In 1923 the output was 137,691,306 pounds, 9.6 per cent of the total. The large total production of copper in the United States in 1924 caused the larger output in Michigan to be a smaller percentage of the total than in 1923. Through 1924 Michigan's total smelter output has been 7,366,947,763 pounds, 21.59 per cent of the country's total. Michigan ranks third among the copper-producing States of the country in total production; Arizona is first and Montana second. In production for 1924 Michigan ranked fourth, with Arizona, Utah, and Montana in the first three places.

The Lake Superior district ranks second among the copper-producing districts of the country in total production since 1845, being surpassed only by the Butte (Mont.) district. The copper ore production of the Lake Superior district for several years is given below. In 1924 the average copper content of ores mined in the district was lower than in 1923. An outstanding development in 1924 for the Lake mines was the reduction by this State in valuation for tax assessment purposes and the announcement of the Michigan Tax Commission that all mines, nonproducing as well as producing, will be placed on an actual cash basis in 1925.

Copper ore produced in Lake Superior district, Mich., 1917–1924

Year	Short tons	Yield of copper (per cent)	Year	Short tons	Yield of copper (per cent)
1917	12,400,723	0.99	1921	3,610,648	1.20
1918	11,321,365	.96	1922	4,952,264	1.23
1919	7,690,253	1.16	1923	5,363,160	1.29
1920	5,938,967	1.30	1924	5,372,572	1.26

The mines of the Calumet & Hecla Consolidated Copper Co. produced 54,510,000 pounds of copper in 1924. The average cost of producing the copper sold, not including depreciation and depletion, was 12.48 cents a pound. The Calumet & Hecla reclamation plant at Lake Linden produced 18,627,000 pounds of copper at an average cost sold of 7.83 cents a pound. The average price received by the company for all copper was 13.05 cents a pound. Three shafts at Ahmeek were sunk a total of 2,110 feet, and drifts were extended a total of 14,942 feet. The results were considered satisfactory, and the tonnage opened up, it is stated, was well in excess of the tonnage mined. About 310,000 tons of stoping ground was developed at the conglomerate branch. The Lake Linden stamp mills treated 689,920 tons of conglomerate rock and the Ahmeek mill stamped 772,272 tons from the Kearsage branch, 36,258 tons from the Seneca Copper Corporation, and 7,848 tons from the Isle Royale Copper Co. The processes employed at the Tamarack reclamation plant correspond with those in use at Lake Linden, and all machinery, so far as possible, is interchangeable between the two plants. The smelter treated a total of

74,544 tons of concentrates and mass during the year, of which 66,647 tons was for the company. Following the recommendations given in a geological survey made for the company of the copper district of Michigan and of the company's properties in particular, Calumet & Hecla started exploratory work on the lands of the Cliff Mining Co. and the La Salle Copper Co. Additional exploratory work recommended is to be undertaken as soon as convenient. The Lake Milling, Smelting & Refining Co. was idle during the entire year but is ready to resume as soon as the interested companies require facilities. On June 16, 1924, a dividend of 50 cents a share was paid to stockholders of record on May 31, 1924.

Operations at the Calumet & Hecla reclamation plant at Lake Linden, 1924, and for the entire period of its operation

	1924	Since starting
Quantity treated.....short tons	1,687,700	9,643,218
Assay headings.....per cent	.683	.707
Assay tailings.....do	.138	1.92
Refined copper produced.....pounds	18,627,000	100,729,924
Refined copper produced per ton treated.....do	11.04	10.45

The Isle Royale Copper Co. in 1924 produced 8,103,000 pounds of copper, at an average cost, including charges of 3.78 cents for depreciation and depletion, of 16.41 cents a pound. The 315,507 tons of rock treated yielded 25.68 pounds of refined copper for each ton of rock treated.

The mines of the Copper Range Co. produced 25,109,175 pounds of refined copper, an increase of 1,537,815 pounds over 1923. The price received for copper during 1924 was 13.76 cents a pound, compared with 14.80 cents in 1923, but as operating costs, exclusive of depreciation and depletion, were about 1 cent a pound less than in 1923, the net return per pound was about the same. A heavy flow of water into the Champion mine caused a reduction of output for the last quarter of the year, but at this mine, the Baltic mine, and the smelter somewhat better operating results were obtained than during the preceding year. Since December, 1922, operations at the Trimountain mine have been limited to drifting and sinking. During the year 33,028 tons of rock were hoisted; 8,159 tons of it was stamped, yielding 34.10 pounds of copper per ton.

Copper produced by the Champion Copper Co., 1915–1924

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound •	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1915	923,743	33,407,599	36.17	6.30	17.40	$3,709,049.02
1916	936,656	33,601,136	35.87	7.80	25.28	5,870,606.26
1917	776,036	27,550,343	35.50	10.50	28.73	5,050,171.57
1918	594,235	21,748,514	36.599	11.92	24.757	2,791,800.38
1919	503,030	19,886,917	39.534	11.62	18.67	1,399,714.19
1920	321,664	13,610,324	42.419	14.40	17.17	399,772.65
1921	531,780	20,719,307	39.018	9.82	13.329	719,955.51
1922	503,593	19,583,806	38.964	9.93	14.359	890,515.16
1923	449,130	18,412,630	41.03	11.14	14.86	738,871.98
1924	457,160	20,061,630	43.88	10.49	13.76	709,276.53
	5,997,027	228,582,206	38.02	9.95	19.58	22,279,733.25

• Excludes depreciation or depletion.

Copper produced by the Baltic mine, 1915–1924

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[a]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1915	378,443	12,028,947	31.79	9.50	17.40	$949,965.40
1916	369,287	12,425,804	33.65	10.85	25.28	1,792,667.75
1917	325,342	11,214,861	34.47	13.77	28.73	1,678,323.39
1918	293,601	10,406,097	35.44	15.07	24.757	1,007,551.97
1919	235,832	7,864,653	33.35	17.53	18.67	89,305.51
1920	175,357	6,613,918	37.71	18.02	17.11	[b] 59,882.60
1921	195,816	7,608,847	38.86	14.15	13.078	[b] 81,668.95
1922	165,804	5,329,568	32.14	16.76	13.958	[b] 149,578.09
1923	137,801	4,877,248	35.51	18.42	14.626	[b] 189,880.94
1924	150,101	4,769,286	31.77	15.95	13.76	[b] 104,574.24
	2,427,384	83,139,229	34.27	14.25	20.13	4,882,229.20

[a] Excludes depreciation or depletion. [b] Deficit.

Copper produced by the Trimountain mine, 1915–1924

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1915	349,684	8,302,896	23.75	9.53	17.40	$654,746.52
1916	349,504	8,720,558	24.94	11.01	25.28	1,236,048.91
1917	264,655	6,278,097	23.72	15.22	28.73	848,241.06
1918	201,433	5,343,586	26.52	19.50	24.757	338,533.03
1919	171,995	5,274,387	30.66	19.39	18.668	51,303.34
1920	116,768	3,532,025	30.24	25.51	17.115	[a] 247,390.52
1921	143,172	4,341,584	30.32	18.27	13.078	[a] 183,560.50
1922	130,913	4,116,100	31.44	16.46	14.359	[a] 67,576.58
1923	6,273	281,482	44.87	(b)	(b)	[a] 140,563.74
1924	8,159	278,259	34.10	(b)	(b)	[a] 87,053.47
	1,742,556	46,468,974	26.66	15.75	20.71	2,402,728.05

[a] Deficit. [b] Figures not given.

The Mohawk mine in 1924 produced 16,735,500 pounds of mineral and mass, which yielded 71.40 per cent of refined copper, or 11,949,841 pounds, a recovery of 24.03 pounds of copper a ton of rock stamped. On account of a shortage of miners operations at the Mohawk mine in 1924 were confined to the No. 4 and No. 6 shafts up to August 28. Then a number of men were imported and operations in No. 1 shaft resumed; the underground force was brought up to 70 per cent of normal and apparently was being further increased at the end of the year. The Mohawk mill ran at 83 per cent of capacity in 1924, stamping Mohawk and Wolverine rock. Except for a period of three weeks, when it stamped the overflow from the Mohawk mill, the Wolverine mill was idle in 1924. The Wolverine mine produced 4,749,145 pounds of mineral and mass in 1924, which yielded 68.756 per cent of refined copper, or 3,265,356 pounds, an extraction of 15.895 pounds a ton of rock stamped. In its report the company stated that the available mineral resources in the Wolverine mine would justify only a few months more of operations.

Copper produced by the Mohawk and Wolverine mines in 1924

Rock hoisted	short tons	734, 060
Rock stamped	do	702, 534
Product of mineral	pounds	21, 484, 645
Refined copper produced	do	15, 215, 197
Yield per ton of rock treated	do	21. 657
Cost per ton of rock hoisted		$1. 898
Cost per ton of rock stamped		$1. 983
Operating cost per pound of refined copper	cents	9. 158
Cost of taxes (exclusive of income and profits)	do	. 403
Cost of smelting, freight, and marketing product, including eastern offices' expenses	cents	1. 848
		11. 409

The Quincy Mining Co. produced 14,838,633 pounds of refined copper in 1924. Operations during the year were conducted at a loss because of the low price of copper, the loss of about $40,000 entailed when a part of No. 6 shaft was crushed and the shortage of underground labor during the summer. In the first quarter of 1925 the higher selling price for copper resulted in a profit of $40,000 for the mine on a production of 4,100,000 pounds. The company says that the new openings, particularly in the deepest levels, are showing well, and although the vein is narrower than in the upper levels the yield of 25.24 pounds of refined copper a ton of rock stamped in 1924 was the highest for any year since 1900.

MONTANA

Montana leads all other States except Arizona in total production of copper from the beginning of operations through 1924, with a smelter production of 8,700,412,043 pounds, or 25.49 per cent of the total for the country. Although the Arizona output comes from a number of important districts, that of Montana comes almost wholly from only one, the Butte district. In 1924 Montana was passed by Utah and ranked third among the copper-producing States, with a production of 249,322,394 pounds, or 15.26 per cent of the total for the country.

Butte district.—The Butte district has produced almost the entire copper output of the State and has yielded more copper than any other district in the country. The Lake Superior district, which ranks next, is well over 1,000,000,000 pounds behind the Butte district for total production from 1845 to 1924.

Copper and associated metals produced in Butte district, Mont., 1918-1924

Year	Copper	Gold	Silver
	Pounds		*Ounces*
1918	321, 104, 000	$899, 007	15, 011, 555
1919	169, 051, 000	576, 756	10, 527, 457
1920	176, 399, 000	643, 595	10, 570, 676
1921	47, 958, 000	280, 085	4, 980, 285
1922	165, 374, 000	540, 936	10, 394, 811
1923	223, 043, 000	624, 528	11, 835, 643
1924	247, 364, 000	730, 646	11, 859, 290

The annual report of the Anaconda Copper Mining Co. for 1924 says:

The mines of the company produced during the year 3,092,151.32 tons of ore and 6,654.26 tons of precipitates were produced from the water pumped from the mines. At the concentrator there were treated 3,079,178.21 tons of ore, 78,752.50 tons of copper tailings, and 55,880.36 tons of zinc-silver tailings. The Anaconda reduction works treated for all companies 3,312,774.65 tons of ore. Of the total amount 3,017,416.70 tons of ore were produced by the mines of the company, 212,319.48 tons of ore were either purchased from or treated for other companies, 19,659.05 tons of material were shipped from the old plants at Anaconda and Great Falls, and 63,379.42 tons from the Great Falls zinc plant. There were produced 238,823,149 pounds of fine copper, 8,383,591.44 ounces of silver, and 37,688.812 ounces gold. Of this production 238,247,038 pounds of fine copper, 8,345,841.35 ounces of silver, and 37,688.812 ounces of gold were produced for your company. The copper refinery at Great Falls produced during the year 209,966,554 pounds of cathodes, of which 202,877,392 pounds were melted into shapes at that point. The Raritan Copper Works at Perth Amboy, N. J., refined 406,548,498 pounds of fine copper, 20,037,558.48 ounces silver, and 117,520.023 ounces of gold. The mill at Great Falls rolled into rods 107,931,230 pounds of copper, and 40,101,844 pounds of rods were drawn into wire, of which 15,559,986 pounds were made into strand.

During the year the Anaconda Co. acquired, for the sum of $3,000,000, the property and assets of the Davis-Daly Copper Co. Litigation over the ownership of a number of veins and ore bodies was ended by this transaction. During 1924 the Anaconda Co. sold only manufactured copper in domestic trade. The entire output, except exports, was taken by the manufacturing plants at Great Falls and those operated by the American Brass Co. The gross income from sales and royalties for the year was $166,467,901.80; the operating profit and income from investments were $21,744,965.25, and the net profit, after deduction of all charges, depreciation, bond discount, etc., amounted to $6,719,215.49. The output of manufactured products of the various plants of the American Brass Co. made a new record in 1924 of 519,749,665 pounds of copper, brass, and nickel-silver. The copper mill at Kenosha was completed and the first wire was drawn on April 17, 1924.

In 1924 the Butte & Superior Mining Co. produced 167,312 tons of copper ore, containing 13,797,257 pounds of copper, 713 ounces of gold, 1,059,760 ounces of silver, 1,378,361 pounds of lead, and 9,726,163 pounds of zinc. The ore reserves at the end of 1924 were estimated to be 304,030 tons of copper ore, as compared with 248,727 tons at the end of 1923.

Shipments of Davis-Daly ore to the East Butte smelter ceased early in March, 1924. This loss in tonnage for the reduction plants and the depressed copper market caused the closing of the East Butte mine and smelter early in August. The company's operations showed a loss of $161,392.77 for the year. With the general improvement in copper prices the stoping of ore was resumed in February, 1925. Through a contract with the Anaconda Copper Mining Co. the East Butte ores are treated at a lower rate than they could be at the East Butte smelter.

Operations of East Butte Copper Mining Co. for 1924

Ore mined (wet weight), Pittsmont—short tons	74,044
Average assay value, copper—per cent	3.85
Average assay value, silver—ounces	2.18
Cost of mining per ton, including development	$7.53
Company ore treated—short tons	67,366
Customs ore treated—do	15,576
Total ore treated—do	82,942
Ore shipped to Anaconda—do	5,862
Copper produced—pounds	7,140,220
Silver produced—ounces	257,026
Gold produced—do	519
Gross value of metals shipped	$1,182,868.57
Other income	$30,916.43
Gross income from operations	$1,213,785.00
Operating cost	$1,280,014.46
Maintenance of properties	$79,106.46
Total cost of operations	$1,359,120.92
Loss on operations	$145,335.92
Depreciation	$2,683.98
Outside exploration	$13,372.87
Deficit from all operations	$161,392.77
Copper shipped to New York—pounds	6,672,505
Price per pound received, New York—cents	13.1287
Cost of production per pound delivered, New York—do	15.3741
Loss per pound—do	2.2454
Average price per ounce received for silver, New York—do	67.83
Price per ounce received for gold, New York	$20.00

The North Butte Mining Co. did not mine any ore in 1924, but lessees produced 6,004 wet tons of ore. Of the 5,825 dry tons treated at the smelter, 3,196 tons was first class, 2,519 tons second class, and 110 tons third class. This ore yielded 576,111 pounds of fine copper, 37,750.09 ounces of silver, and 40.248 ounces of gold. The Metals Sales Corporation delivered 653,018 pounds of copper for the North Butte Copper Co. at an average price of 13.2243 cents a pound, 42,385.39 ounces of silver at 66.6109 cents an ounce, and 40.248 ounces of gold at $20 an ounce.

Copper, silver, and gold produced by North Butte Mining Co., 1918–1924

Year	Copper ore and precipitates treated	Copper	Silver	Gold	Dividends
	Short tons	*Pounds*	*Ounces*	*Ounces*	
1918	453,356	20,680,695	891,157	1,375	$430,000
1919	287,800	14,331,254	633,215	914	
1920	315,233	16,666,819	693,633	1,004	
1921	24,755	1,229,600	34,536	78	
1922	172,749	9,504,389	308,681	568	
1923	157,871	7,891,177	298,548	545	
1924	[a] 5,825	[a] 576,111	[a] 37,750	[a] 40	

[a] By lessees.

NEVADA

In 1923 Nevada joined the group of States that have had a cumulative output of over 1,000,000,000 pounds of copper since the beginning of operations, and at the end of 1924 its total production had become 1,118,684,452 pounds, 3.28 per cent of the total for the country since 1845. In total output Nevada thus ranks fifth among the copper-producing States. In production for 1924 Nevada ranked sixth, with 77,281,479 pounds of copper, representing 4.73 per cent of the country's total.

Ely district.—The Ely district is by far the most important copper-producing district in Nevada. In total output it ranks eighth among the copper-producing districts of the country, its production through 1924 falling a little short of 1,000,000,000 pounds.

Production of metals in Ely (Robinson) district, Nev., 1917–1924

[Mine figures]

Year	Ore	Copper produced	Average yield in copper	Gold and silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1917	4,466,017	[a] 93,615,355	1.05	18
1918	4,519,445	[a] 92,396,638	1.02	24
1919	2,273,961	47,871,048	1.05	17
1920	2,589,546	48,347,828	.93	21
1921	400,810	10,282,527	1.28	25
1922	630,871	22,614,736	1.79	19
1923	2,833,674	65,928,279	1.16	24
1924	3,505,362	73,279,064	1.05	21

[a] Smelter production.

The Nevada Consolidated Copper Co. contributes the bulk of the production of the Ely district. In 1924 the company produced 70,237,050 pounds of refined marketable copper at a cost of 10.70 cents a pound. This cost included taxes, except Federal taxes, all fixed and general administrative expenses, and current charges for depreciation of plants and equipment, but not for depletion; it covers credits for miscellaneous income and gold and silver values. The corresponding cost for 1923 was 10.92 cents a pound. In 1924, after the regular charge for depreciation of plant and equipment, net earnings of $1,675,509.77 were carried to surplus, making a net profit of 84 cents a share of capital stock. In order to extract the total reserves in the most advantageous and economical way, the company anticipates mining ore within the next two years by underground methods to supplement the open-pit method now employed. Prospecting of the Kimberly ore body increased the estimated reserves to 1,912,400 tons, averaging 1.62 per cent of copper on January 1, 1925. In 1924 the structure to house the 26 fine grinding ball mills, of 500-ton daily capacity each, was completed, and three additional mills and the necessary concentrating equipment, including tables, flotation cells, etc., were put in operation. This brings the total in operation to 22 mills, with a daily nominal capacity of 11,500 tons. There were 3,418,900 dry tons of ore, averaging 1.198 per cent copper, milled during the year, compared with 2,576,388 tons, averaging 1.31 per cent of copper in 1923. The average concentrator recovery for the year was 87.09 per cent. Minor changes in flow sheet and improved metallurgy resulted during the last quarter of the year in an average mill recovery of 90.85 per cent on lower than average heads.

Metals produced by Nevada Consolidated Copper Co., 1918–1924

Year	Ore treated	Average assay of copper	Average extraction of copper	Refined copper produced	Dividends
	Short tons	*Per cent*	*Per cent*	*Pounds*	
1918	3,999,526	1.506	67.28	76,607,062	$6,498,235
1919	2,135,425	1.599	70.49	43,971,892	2,999,186
1920	2,568,588	1.449	70.20	48,311,985	1,499,593
1921	392,645	1.49	75.23	9,362,325	
1922	518,523	1.60	75.19	23,762,675	
1923	2,576,388	1.31	82.90	61,573,246	
1924	3,418,900	1.198	87.09	70,237,050	

Ore reserves of Nevada Consolidated Copper Co., December 31, 1924

	Pits		Ruth ore body				Total	
			Porphyry		Sedimentary rock			
	Tons	Per cent	Tons	Per cent	Tons	Per cent	Tons	Per cent
Ore developed to Dec. 31, 1924	82,700,457	1.470	15,689,768	2.22	489,718	6.898	98,879,943	1.620
Ore mined to Dec. 31, 1923	32,759,045	1.528	5,243,776	1.930	196,462	6.080	38,199,283	1.607
	49,941,412	1.429	10,445,992	2.368	293,256	7.446	60,680,660	1.620
Ore mined in 1924	2,723,719	1.112	694,476	1.555	37,405	7.018	3,455,600	1.265
Balance remaining Dec. 31, 1924	47,217,693	1.447	9,751,516	2.426	255,851	7.509	57,225,060	1.641

The smelter returns on 24,930 dry tons of ore produced by the Consolidated Coppermines Corporation in 1924 were as follows: 2,830,715 pounds of copper, 54,566 pounds of lead, 20,059 pounds of zinc, 109.723 ounces of gold, and 7,004.83 ounces of silver. During the latter part of the year leaching in place was started at the Brooks mine. The average circulation approximated 230 gallons a minute, carrying 7.14 pounds of copper per 1,000 gallons, and the plant recovery was 86.73 per cent. The result indicates that certain areas will be leached more easily than others.

Yerington district.—The Mason Valley and Bluestone mines of the Mason Valley Mines Co. were nonproductive in 1924. The company has decided to concentrate the sulphide ores of the Mason Valley and Bluestone mines instead of smelting them direct as heretofore, and consequently a larger capacity is necessary at the Bluestone mills where the ores will be concentrated. Necessary additions and improvements have been determined, and the company expected it would be ready to operate in the summer of 1925.

NEW MEXICO

The production of copper in New Mexico in 1924 amounted to 78,145,629 pounds, 4.78 per cent of the total for the country, giving New Mexico fifth place among the copper-producing States. In 1923 New Mexico ranked seventh, with a production of 57,521,171 pounds, 4.01 per cent of the country's total. In cumulative production of the country since 1845 New Mexico has ranked seventh, with a production of 880,997,524 pounds, 2.58 per cent of the total.

At the end of 1923 Alaska ranked seventh, having displaced New Mexico in that year. The Central district is by far the largest copper-producing district in the State.

Central (including Santa Rita) district.—The production of the Central district for several years is given below:

Copper produced in Central (including Santa Rita) district, N. Mex., 1917–1924, in pounds

1917	82, 200, 000	1921	9, 138, 000
1918	77, 547, 000	1922	28, 408, 000
1919	40, 359, 000	1923	54, 375, 000
1920	44, 400, 000	1924	66, 824, 000

The Chino mines of the Ray Consolidated Co., after allowance for smelter deductions, produced 66,574,486 pounds of refined copper in 1924. The total ore and waste removed by power shovels in 1924 was equivalent to 4,556,329 cubic yards in place. Of this amount 2,770,017 cubic yards was capping, the remainder being equivalent to 3,310,546 tons of ore. Of this ore 2,703,657 tons was sent to the mill, 33,698 tons was shipped direct to the smelter, and 573,191 tons was placed on the stock pile at Santa Rita. Five sections of the Hurley mill and the regrinding portion of the sixth section were in operation throughout 1924. A total of 2,706,200 dry tons of ore was treated, which contained an average of 1.59 per cent of copper, approximately 0.09 per cent higher than in 1923. The 141,579 dry tons of concentrates produced averaged 23.68 per cent of copper, corresponding to a recovery of 24.78 pounds a ton. The average extraction was 77.83 per cent, but mechanical and other improvements made during the year and a change in flotation reagents in October increased the extraction from 72.63 per cent in the first quarter to 83.02 per cent in the fourth quarter. The ore reserves of the mines are given as 95,299,298 tons of fully developed ore, averaging 1.528 per cent of copper, in addition to unmined reserves of 3,036,558 tons of ore, averaging 1.227 per cent of copper, in the stock piles at Santa Rita, and 88,465 tons in a special reserve for experimental purposes, averaging 1.37 per cent of copper, a total of 98,424,321 tons, averaging 1.526 per cent of copper

Metals produced by Chino mines of the Ray Consolidated Copper Co., N. Mex., 1918–1924

Year	Ore milled	Copper content	Mill recovery	Refined copper produced	Gold, silver, and miscellaneous income	Dividends
	Short tons	*Per cent*	*Per cent*	*Pounds*		
1918	3, 836, 400	1. 63	63. 275	75, 655, 641	$0. 109	[a] $3, 914, 910
1919	1, 765, 200	1. 82	65. 67	40, 488, 706	. 216	[b] 2, 609, 940
1920	1, 838, 140	1. 76	70. 67	44, 051, 849	. 570	[c] 978, 728
1921	361, 660	1. 70	77. 36	9, 137, 282	. 570	
1922	1, 416, 869	1. 55	66. 99	28, 406, 314	. 90	
1923	2, 785, 564	1. 50	66. 34	54, 261, 228	. 37	
1924	2, 706, 200	1. 59	77. 83	66, 574, 486	[d] . 22	

[a] $1,087,475 represents distribution of capital.
[b] Total represents distribution of capital; no dividends paid during 1919.
[c] $652,485 represents distribution of capital.
[d] Computed for Ray and Chino mines together.

Burro Mountain district.—Work at the Burro Mountain Branch of the Phelps Dodge Corporation was confined, as in 1923, to leaching the waste dumps and to leasing operations. This work yielded 2,655,093 pounds of copper and almost enough profit to carry the taxes and overhead expenses. The plant and underground workings have been adequately maintained in good repair and the mines kept free from water, so that when market conditions justify mine production can be resumed within a reasonable time.

Lordsburg district.—The Eighty-Five Branch of the Calumet & Arizona Mining Co. in 1924 mined 83,694.9 wet tons, or 80,475.9 dry tons of ore. There were 874 tons of ore mined by lessees from the Superior claim during the year.

The production of the Lordsburg district for several years is given below:

Copper produced in Lordsburg district, N. Mex., 1917–1924, in pounds

[Mine figures]

1917	4, 262, 000	1921	579, 000
1918	2, 215, 000	1922	3, 217, 000
1919	3, 516, 000	1923	4, 314, 000
1920	2, 696, 000	1924	4, 928, 000

TENNESSEE

The smelter production of copper in Tennessee from 1845 through 1924 has totaled approximately 449,753,000 pounds, or 1.32 per cent of the total for the country, giving Tennessee ninth place among the copper-producing States. In production for 1923 and 1924 Tennessee has ranked ninth also, with 18,721,932 pounds, 1.30 per cent of the country's total, in 1923, and 18,251,996 pounds, 1.12 per cent of it, in 1924. Tennessee is the only important copper-producing State in the East. The entire production has come from Ducktown district, Polk County, in the extreme southeastern part of the State.

Copper produced in Ducktown district, Tenn., 1918–1924

Year	Copper ore treated	Copper produced (smelter)	Average yield of copper	Goldand silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1918	529, 012	15, 053, 568	1. 42	18
1919	555, 018	15, 629, 454	1. 41	21
1920	589, 853	16, 727, 803	1. 42	21
1921	564, 457	15, 084, 294	1. 34	18
1922	557, 750	14, 226, 232	1. 28	15
1923	776, 477	18, 721, 932	1. 21	12
1924	714, 975	18, 251, 996	1. 28	10

The Burra Burra and London mines of the Tennessee Copper Co. were active throughout the year, and 464,645 tons of ore was produced. For all mines except the Eureka the estimated ore reserves at the end of the year were 3,691,678 tons, of which 82,950 tons was broken in stopes. The estimated reserves are divided as follows: Burra Burra, 3,543,400 tons; London, 92,728 tons; and Polk County, 55,550 tons. The flotation plant treated approximately 25 per cent more ore than in 1923, and the actual recovery was raised from 84.9 per cent to 88 4 per cent. At the same time the cost per ton was decidedly lowered. Flotation operations are shown below:

Results at flotation plant of Tennessee Copper Co. in 1924

Ore milled (dry)	short tons	144,683
Average heads assay	per cent	1.55
Concentrate produced	short tons	17,179
Average concentrate assay	per cent	11.52
Ratio of concentration		8.4:1
Actual recovery	per cent	88.4
Cost per ton of ore		$0.791

Smelting operations were restricted from February to August, and most of the time only one 22½-foot furnace was in blast. In the fall two furnaces were in blast and a large tonnage of ore was smelted. The smelter recovery was about 5 per cent higher than in 1923. The 451,777 tons of Tennessee Copper Co. ore treated during the year yielded 12,566,576 pounds of fine copper, an extraction of 27.82 pounds a ton. In addition, 160,059 pounds of fine copper was recovered from other sources, making a total production of 12,726,635 pounds of fine copper. The cost of fine copper in pig, including freight, commission, taxes, legal and administrative expenses, etc., was 13.5 cents a pound in 1924, compared with 15.3 cents a pound in 1923.

The Ducktown Sulphur, Copper & Iron Co., which contributes the remainder of the copper produced in Tennessee, operated throughout the year.

Copper and sulphuric acid produced by Tennessee Copper Co., 1918–1924

Year	Ore smelted	Copper	Sulphuric acid, 60° Baumé	Dividends
	Short tons	*Pounds*	*Short tons*	
1918	402,071	9,819,838	283,092	$392,817
1919	413,877	10,414,815	266,627	----------
1920	404,060	10,358,237	333,629	----------
1921	302,584	8,018,577	242,743	----------
1922	287,499	7,553,281	218,676	----------
1923	484,324	12,013,988	299,231	[a]
1924	451,777	[b] 12,566,576	247,477	[c]

[a] Three quarterly dividends of 25 cents a share.
[b] Exclusive of 160,059 pounds of copper from other sources.
[c] A dividend of 25 cents was declared payable Jan. 15, 1924, to stockholders of record Dec. 31, 1923.

UTAH

Utah, which for a number of years ranked as the fourth largest copper-producing State, was third in 1923, and second in 1924 when only Arizona was ahead of it. The production in 1924 amounted to 256,531,349 pounds, or 15.70 per cent of the country's total, an increase from 210,118,291 pounds, representing 14.64 per cent of the total, in 1923. In cumulative production from the beginning of operations Utah holds fourth rank, with a production of 2,954,878,164 pounds, which represents 8.66 per cent of the country's total from 1845. As is true of Montana and Michigan, the two States which rank second and third, respectively, in cumulative production, the Utah output comes from mainly one district.

Bingham district.—The Bingham district, which yields the bulk of Utah's copper production, ranks fourth among the copper-producing districts of the country in output through 1924. The production for several years is given below:

Copper produced in Bingham district, Utah, 1917–1924, in pounds

[Mine figures]

1917	225, 412, 000	1921	28, 011, 000
1918	211, 195, 000	1922	91, 762, 000
1919	116, 697, 000	1923	216, 037, 000
1920	110, 670, 000	1924	236, 181, 000

The Utah Copper Co. in 1924 mined 12,126,600 tons of ore by shovels and shipped it to the mills. The total tonnage of milling ore produced from the entire property up to December 31, 1924, was 119,356,251 tons, which averaged 1.31 per cent copper. By deducting the ore mined in 1924 from the reserves previously reported the reserves at the end of the year are found to be 335,251,449 tons, averaging approximately 1.35 per cent copper. The Magna mill treated 6,522,800 tons of ore in 1924 and the Arthur mill treated 5,603,800 tons, making a total of 12,126,600 tons, a daily average of 33,406 tons. The average grade of ore treated was 1.07 per cent of copper, compared with 1.12 per cent in 1923, and the average recovery was 85.94 per cent, compared with 80.96 per cent, an extraction of 18.43 pounds per ton of ore treated, compared with 18.18 pounds in 1923. The reconstruction program at the Magna mill was completed early in the year, and the two mills now have a combined daily capacity of 40,000 tons. After allowance for losses in smelting and refining the net production of refined copper by the Utah Copper Co. was 214,592,733 pounds. The average cost, including depreciation of plant and equipment and all fixed and general expenses, and covering credits for gold, silver, and miscellaneous earnings, was 8.89 cents a pound of copper, compared with 8.74 cents a pound in 1923. The net income from metal production after deduction of operating expenses was $9,651,705.43; adding miscellaneous earnings, amounting to $614,053.05, gives a total income of $10,265,758.48. Deducting charges for depreciation of plants and equipment and other non-operating profit and loss items and making provision for Federal income tax left a net credit to surplus of $8,185,319.51, equivalent to $5.04 a share on 1,624,490 shares of outstanding stock at the close of the year.

The geological features and court decisions of the Utah Apex-Utah Consolidated controversy are discussed by Orrin P. Peterson[4] in the December, 1924, issue of Mining and Metallurgy.

Metals produced by Utah Copper Co., from ore milled, 1918–1924

Year	Ore milled	Copper content	Mill recovery	Copper [a]	Gold and silver per pound of copper	Dividends (includes capital distribution)
	Short tons	*Per cent*	*Per cent*	*Pounds*	*Cents*	
1918	12, 160, 700	1. 226	65. 11	188, 092, 405	0. 79	$16, 244, 900
1919	5, 538, 700	1. 26	78. 46	105, 088, 740	. 83	9, 746, 940
1920	5, 556, 800	1. 16	81. 38	101, 897, 758	. 81	9, 746, 940
1921	1, 220, 700	1. 16	83. 87	24, 511, 593	[b] 1. 15	4, 061, 225
1922	4, 364, 251	1. 26	80. 00	84, 777, 712	[b] 1. 45	3, 248, 980
1923	11, 167, 800	1. 12	80. 96	195, 142, 919	[b] 1. 313	6, 497, 960
1924	12, 126, 600	1. 07	85. 94	214, 592, 733	[b] 1. 206	6, 497, 960

[a] Net production of refined copper, not copper content of concentrates.
[b] Includes miscellaneous income. Comparative figure for 1920 is 2.09 cents

[4] Peterson, Orrin P., "Some geological features and court decisions of the Utah Apex-Utah Consolidated controversy, Bingham district": Mining and Metallurgy, vol. 5, December, 1924, p. 597.

Cost of mining, milling, and concentrating copper ore by Utah Copper Co., 1918–1924

Year	Ore (short tons)	Cost per ton			
		Mining	Transportation	Milling	Total
1918	12,160,700	$0.5370	$0.2983	$0.9277	$1.7630
1919	5,538,700	.4900	.3040	1.2062	2.0002
1920	5,556,800	.4823	.2591	1.2472	1.9886
1921	1,220,700	.4998	.1921	1.1679	1.8598
1922	4,364,251	.3833	.1612	.8417	1.3862
1923	11,167,800	.3488	.1088	.6116	1.0692
1924	12,126,600	.3605	.1308	.5990	1.0903

The method of recovering copper by leaching of caved ore in place, used by the Ohio Copper Co., of Utah, is briefly discussed in the chapter on copper in Mineral Resources for 1923. Operations at the mine were continuous throughout the year, and 11,115,329 pounds of copper was produced. The operating profits are given as 7.0610 cents a pound, a total of $784,759.56, which, including miscellaneous income, amounts to $787,708.69. Deducting interest on bonds and other indebtedness, local and Federal taxes, insurance, administration, and miscellaneous expenses, the net profits were $589,758.33. Leaving a reserve for depreciation of new plant and a reserve for depletion, the balance transferred to surplus was $398,133.84.

Copper production of the Ohio Copper Co., of Utah, 1924

1924	Copper produced	Cost per pound	Price per pound	Profit per pound	Operating profits
	Pounds	*Cents*	*Cents*	*Cents*	
First quarter	2,419,830	6.0948	12.8200	6.7252	$162,739.34
Second quarter	3,167,461	5.4780	12.6518	7.1738	227,228.79
Third quarter	2,868,240	5.7867	12.7439	6.9572	199,548.79
Fourth quarter	2,659,798	6.0500	13.4000	7.3500	195,242.64
	11,115,329	5.8150	12.8760	7.0610	784,759.56

Owing to the depressed condition of the copper market the Montana-Bingham Consolidated Mining Co. suspended operations early in the year.

The Bingham Mines Co. discontinued the shipment of copper ore from the Dalton and Lark mines. It reported the suspension was due to a falling off in grade, the high costs of mining, and the low price of copper. Copper ore has heretofore constituted the bulk of the mines' production.

Tintic district.—The production of the Tintic district for several years is shown below:

Copper produced in Tintic district, Utah, 1917–1924, in pounds

[Mine figures]

1917	9,118,000	1921	1,570,000
1918	6,569,000	1922	2,295,000
1919	3,251,000	1923	3,033,000
1920	3,003,000	1924	3,076,000

REFINERY PRODUCTION

The refinery output of copper in the United States in 1924 was made by 11 plants, 8 of which employed the electrolytic method and 3 employed the furnace process on Lake Superior copper. The Calumet & Hecla Consolidated Copper Co. usually employs both methods, but the electrolytic plant has not been in commission since December, 1922, as the silver content of the copper is not enough to pay for its recovery.

Six of the large electrolytic refineries are on the Atlantic tidewater, and the three Lake refineries are on the Great Lakes; only two plants are located west of the Great Lakes—one at Great Falls, Mont., and one at Tacoma, Wash. In addition to these refineries there are numerous plants in different parts of the country that make a considerable output from old copper, brass, and other alloys of copper. The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

Refinery production from ores of domestic and foreign origin is shown in the table on page 411. The domestic figure is the one which is to be compared with smelter production from domestic sources, the main difference being the time factor explained in the introduction to this report, by which the figures for refinery production include copper that was mined some three months earlier than the beginning of the calendar year and smelted probably one or two months earlier.

CASTING AND PIG COPPER

Blister copper that is low in precious metals and free enough from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries so small a content of precious metals that, together with the added value of electrolytic copper, it will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is small. Some blister or pig copper low in precious metals has been exported without further treatment and is probably consumed without electrolytic refining. A large percentage of the pig and casting copper shown in the table is from Arizona. Some of the districts produced a rather high grade of blister copper carrying a small amount of precious metals, and it is found profitable to market some of this copper without electrolytic refining. During 1924 the production of furnace-refined new casting copper amounted to 29,657,925 pounds. No unrefined pig and best select copper was reported as produced in 1924.

LAKE COPPER

Lake copper, as the term is used in this report, means the output of the Lake smelters. Ordinarily a considerable proportion of this output is refined electrolytically, but most of the electrolytically refined Lake copper is mixed with furnace-refined copper or is sold as some brand of Lake copper. Since December, 1922, however, the electrolytic plant of the Calumet & Hecla Consolidated Copper Co.

has not been in commission because the silver content of the copper was not sufficient to pay for its recovery. The Quincy Mining Co. was the only company that reported having had any Lake copper electrolytically refined in 1924. The production of Lake copper in 1924 amounted to 145,333,227 pounds.

ELECTROLYTIC COPPER

In the table under the next heading all new copper that was refined electrolytically, except that from the Lake district that was sold as Lake copper, is included under electrolytic copper. In 1924 the production of electrolytic copper from primary materials of domestic origin amounted to approximately 1,499,223,000 pounds and from materials of foreign origin to 577,100,000 pounds, and in addition 104,281,000 pounds was produced from secondary sources—a total electrolytic production of 2,180,604,000 pounds for the year, compared with 1,897,625,000 pounds for 1923.

REFINED COPPER

The total output of new refined copper in 1924 was 2,260,000,000 pounds, an increase of 280,000,000 pounds over that in 1923. Adding to the new refined copper produced from domestic and foreign sources the imports of refined copper gives the new copper made available for consumption during the year. In this table is shown also the production of secondary copper by the regular refineries, but not the output of plants that treat only secondary material, which is shown in another table.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1919–1924, in pounds

	1919	1920	1921	1922	1923	1924
Primary:						
Domestic[a]—						
Electrolytic	1,233,994,324	1,010,240,867	506,532,984	766,944,836	1,302,454,492	1,499,223,447
Lake	177,594,135	153,483,952	100,918,001	122,545,126	137,691,306	145,333,227
Casting	18,223,145	13,905,114	1,746,393	15,180,723	24,019,197	29,657,925
Pig and best select	3,674,191	4,793,307	222,878			
	1,433,485,795	1,182,423,240	609,414,256	904,670,685	1,464,164,995	1,674,214,599
Foreign[a]—						
Electrolytic	335,420,019	341,451,660	336,088,209	345,641,677	509,873,512	577,100,034
Casting and best select	1,262,227	2,290,446	5,275,350	5,203,597	5,797,109	8,761,377
Refinery production new copper	1,770,168,041	1,526,165,346	950,777,815	1,255,515,959	1,979,835,616	2,260,076,010
Imports refined copper	35,138,760	108,743,298	69,249,281	103,143,142	[b] 160,711,227	145,909,968
Total new refined copper made available	1,805,306,801	1,634,908,644	1,020,027,096	1,358,659,101	2,140,546,843	2,405,985,978
Secondary:						
Electrolytic	32,408,548	32,856,549	82,017,382	100,792,685	85,297,052	104,281,430
Casting	38,876,481	49,130,510	24,467,951	45,217,857	46,141,409	50,536,678
	71,285,029	81,987,059	106,485,333	146,010,542	131,438,461	154,818,108
Grand total	1,876,591,830	1,716,895,703	1,126,512,429	1,504,669,643	2,271,985,304	2,560,804,086

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[b] The figures of imports of refined copper from Chile in 1923 reported by the Chile Exploration Co. have been included in place of the figures of the Bureau of Foreign and Domestic Commerce for Chile, which undoubtedly are very low.

If the output of plants treating only secondary material is added to the production of the regular refining companies, the contribution from plants in the United States to the world's supply of copper for 1924 is found to be 3,037,000,000 pounds.

SECONDARY COPPER

Under secondary copper is considered material recovered from remelting old copper, copper scraps, and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. A canvass of plants producing secondary copper has been made by J. P. Dunlop, of the Bureau of Mines, and the following figures are taken from his report:

Secondary copper recovered in the United States in 1924, with imports and exports of scrap brass and copper, in short tons

Copper as metal	141,500
Copper in alloys other than brass	55,000
	196,500
From new scrap (not including brass)	36,000
From old scrap (not including brass)	160,500
	196,500
Brass scrap melted:	
New clean scrap	123,000
Old scrap	151,000
	274,000
Copper content of brass scrap (averaging about 70 per cent copper):	
New scrap	86,100
Old scrap	105,700
	191,800
Total copper produced from secondary sources (including copper content of brass scrap):	
From new scrap	122,100
From old scrap	266,200
	388,300
Imports of scrap brass	4,636
Imports of scrap copper	1,855
Exports of scrap brass	29,294
Exports of scrap copper	2,597

In addition to the secondary material treated by the regular refining companies, plants that treated secondary material exclusively produced a total of about 621,782,000 pounds of copper as copper and in brass and other alloys of copper, making a total production of 776,600,000 pounds from secondary sources. Of this total at least 244,200,000 pounds was produced by remelting clean scrap produced in the manufacture of copper and brass articles.

Refined copper from secondary sources produced in the United States, 1917–1924, in pounds

1917	766,800,000	1921	434,600,000
1918	705,340,000	1922	671,800,000
1919	574,380,000	1923	821,800,000
1920	624,920,000	1924	776,600,000

COPPER SULPHATE

The production of hydrous copper sulphate or bluestone by the copper refineries of the United States in 1924 was 22,638,431 pounds, having a copper content of 5,766,000 pounds, as against 31,354,828 pounds, having a copper content of 7,987,000 pounds, in 1923.

STOCKS

Stocks of copper in the United States January 1, 1919–1925, in pounds

Year	Refined copper	Blister and material in process of refining	Year	Refined copper	Blister and material in process of refining
1919	180,000,000	562,600,000	1923	216,000,000	361,000,000
1920	631,000,000	273,000,000	1924	264,000,000	432,000,000
1921	659,000,000	465,000,000	1925	243,000,000	393,000,000
1922	459,000,000	283,000,000			

IMPORTS AND EXPORTS

The quantity of copper in unmanufactured form imported into the United States in 1924 was 768,813,731 pounds, compared with 676,473,338 pounds in 1923. Individual reports received from some of the large importers of copper show that some of the data entering into the compilations by the Bureau of Foreign and Domestic Commerce have been wrongly classified. They indicate clearly that the figures for imports of refined copper in 1923 reported by the Bureau of Foreign and Domestic Commerce are many million pounds short, and it is probable that the shortage is made up mainly in refined copper reported as unrefined copper.

Copper (unmanufactured) imported into the United States, 1923–1924, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black copper and copper in bars, pigs, or other forms	Refined in bars, plates, rods, or other forms	Old and clippings for remanufacture	Composition metal, copper chief value
1923							
Africa:							
British South	9,525	33,174					
Portuguese—							
East	64,908			17,187,927			
Other				53,031,418	380,120		
Australia	107,246			2,872,973			
Bolivia	62			2,151,357	163,229		
Canada	19,374,037	279,003	2,192,826	42,514,549	1,054,078	1,771,377	373,787
Chile	45,044,926	22,982		106,077,067	118,446,874	176,641	2,232,393
Cuba	9,735,954	13,666,280	5,060	1,645		737,748	12,135
France	336,978	6,097	33,500	2,813,867	3,786,859	34,026	
Germany	1,299,725		1,473	1,215,413		332,797	89,313
Mexico	2,319,922	34,362,617		82,161,843		65,470	
Peru	1,182,890	229,795		77,893,297	113,268	13,300	
Spain	7,494,217	482,688		4,160,761	2,905,493		
United Kingdom	102,398	200,485	46,563	556,959	1,617,790	1,904,531	1,492,817
Venezuela	1,450,886	351,254				220	
Other	1,629,029	306,380	681,427	2,624,208	246	449,239	1,996
	90,152,703	49,940,755	2,960,849	395,263,284	128,467,957	5,485,349	4,202,441
Total value	$11,735,291	$6,861,987	$408,666	$56,563,515	$19,119,537	$606,485	$599,993

Copper (unmanufactured) imported into the United States, 1923–1924, in pounds—Continued

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black copper and copper in bars, pigs, or other forms	Refined in bars, plates, rods, or other forms	Old and clippings for remanufacture	Composition metal, copper chief value
1924							
Africa:							
British South				672, 560			
Portuguese—							
East	70, 378			34, 330, 735			
Other				90, 487, 936			
Australia				1, 234, 050			
Bolivia	262, 167						
Canada	27, 350, 280	1, 396, 411	35, 468	51, 121, 265	1, 109, 769	2, 328, 947	150, 161
Chile	46, 584, 230	1, 352, 352	145, 030	124, 283, 121	141, 247, 852	35, 840	
Cuba	11, 969, 920	11, 429, 580				521, 909	
France	592, 511	6, 048	13, 642	3, 376, 036	633, 645	9, 588	1, 312
Germany		37, 318	21, 159	44, 990	17, 200	59, 043	14, 862
Mexico	2, 987, 404	22, 687, 382	48, 500	69, 963, 716	477, 252	10, 317	
Peru	1, 731, 222	46, 185	13, 222	74, 951, 579		5, 946	
Spain	10, 312, 123	284, 785		16, 505, 918			
United Kingdom	155, 647	922, 254	497, 101	2, 812, 324	2, 409, 884	128, 373	21, 180
Venezuela		1, 908, 480					
Other	3, 150, 336	1, 666, 461	279, 356	1, 244, 604	14, 366	609, 107	21, 392
	105, 166, 218	41, 737, 256	1, 053, 478	471, 028, 834	145, 909, 968	3, 709, 070	208, 907
Total value	$12, 807, 225	$4, 693, 029	$125, 288	$59, 462, 150	$18, 556, 174	$402, 260	$43, 170

Copper (unmanufactured) imported into the United States, 1918–1924, in pounds

[General imports]

1918	575, 805, 115	1922	541, 013, 220
1919	429, 387, 594	1923	676, 473, 338
1920	485, 670, 691	1924	768, 813, 731
1921	350, 472, 611		

The exports of metallic copper (exclusive of ore, concentrates, and composition metal) in 1924 amounted to 1,116,775,136 pounds, as compared with 828,854,827 pounds in 1923. In both years the figures for exports of metallic copper exclude unrefined copper, but the amount was negligible and the figures for it can not be separated from those for ore and concentrates.

Copper exported from the United States, 1923–24, by kind and destination, in pounds

Destination	Ore, concentrates, and unrefined copper (copper content)	Refined, in bars, ingots, or other forms	Composition metal, copper chief value	Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Rods	Insulated wire and cable	Other manufactures of copper	Total
1923											
Belgium		54,826,830		36,676			18,340	1,224,170	5,875	4,532	56,116,423
Canada	21,420	19,792,565	36,307	2,632,272	1,331,296	1,266,881	638,943	19,790,054	863,170	991,166	47,364,074
China		31,857,222			28,982	17,293	29,384		233,384	28,950	32,195,215
Denmark	440	2,445,787				1,122	2,865	5,816,513	11,572	818	8,279,147
France		183,189,925	24,569				14,030	3,584,982	137,838	590,313	187,541,657
Germany		135,930,884		352,660				302,684	67	764,025	137,350,320
India (British)		1,655,004	30,029		407	987,599	226,276		83,338	32,304	3,014,957
Italy		71,129,684		54,722		600	5,046	112,000	17,069	224,036	71,543,157
Japan	205,040	21,022,202	915	282,124	45	4,898	24,093	340	1,043,288	12,643	22,595,588
Netherlands		16,471,295			5,809	18,040	74,568	649,726	2,655	7,046	17,229,139
Norway		640,415			3,291		9,287	1,230,692	122,878	16,112	2,022,675
Spain		5,796,729			260	527	234,953		84,426	7,931	6,124,826
Sweden		27,531,227					470	67,345	160	10,548	27,609,750
Switzerland		542,251					1,083	716,705		1,160	1,261,199
United Kingdom	112,312	148,674,614		146,571	689	937,040	704,526	28,611,629	484,790	736,605	180,408,776
Other Europe		3,260,789				18	9,274		9,568	5,314	3,284,963
Other countries		4,612,784	28,143	39,520	1,242,614	1,301,725	7,849,854	586,465	8,581,372	1,129,659	25,372,136
	339,212	729,380,207	119,963	3,544,545	2,613,393	4,535,743	9,842,992	62,693,305	11,681,450	4,563,192	829,314,002
1924											
Belgium		76,954,752		64,548		67,262	234,532	1,043,089	70	334	78,364,587
Canada	15,467	30,946,501	39,247	2,031,679	1,109,166	1,545,578	341,949	10,296,685	997,006	1,634,683	48,957,961
China		63,128,544	199	51,205	629	16,740	12,961		102,455	17,998	63,330,731
Denmark		2,612,117				2,320	355	4,481,629	25,224	7,168	7,128,813
France		195,504,959		429,084		465,852	116,660	1,231,739	86,127	792,646	198,627,067
Germany		206,846,136		1,004,009	150	209,832	2,070	728,268		33,882	208,824,347
India (British)		4,501,706			10	488,654	71,214		98,013	24,560	5,184,157
Italy		107,989,642		253,786		918,265		103,400	8,070	66,217	109,339,380
Japan		19,055,608	406	185,958	15,281	114,847	9,688	4,025	73,133	11,376	19,470,322
Netherlands		59,221,141		166,429	8,924	243,108	105	852,308	19,104	801	60,511,920
Norway		1,845,311			169	88,472	2,505	1,617,310	21,794	822	3,576,383
Spain		5,251,322					117,000	3,000	59,362	45,917	5,476,601
Sweden		28,031,537			25		1,533		3,252	2,420	28,038,767
Switzerland		1,538,794					1,269	89,600		25,286	1,654,949
United Kingdom	25,453	198,656,260		793,875	1,231	1,575,307	363,478	39,342,119	1,022,059	870,088	242,649,870
Other Europe		3,880,901				2,420	1,448	560,268	48,481	5,269	4,498,787
Other countries	14,625	3,659,761	44,951	213,479	1,514,231	1,033,993	8,466,774	2,264,982	12,907,308	1,160,738	31,280,842
	55,545	1,009,624,992	84,803	5,194,052	2,649,816	6,772,650	9,743,541	62,618,422	15,471,458	4,700,205	1,116,915,484

Copper exported from the United States, 1918–1924

Year	Pounds		Total value
	Metallic*	Total	
1918	744,243,481	747,689,580	$195,840,637
1919	515,595,019	516,627,775	117,417,055
1920	623,158,489	624,053,701	127,468,606
1921	628,415,714	628,804,750	85,351,928
1922	742,755,957	743,039,888	103,874,007
1923	828,854,827	829,314,002	129,219,975
1924	1,116,775,136	1,116,915,484	156,645,684

* Exclusive of ore, concentrates, and composition metal, and in 1923 and 1924 of unrefined copper, figures for which are not separable from those for ore and concentrates.

Copper sulphate (blue vitriol) exported from the United States, 1918–1924

Year	Pounds	Value	Year	Pounds	Value
1918	14,477,339	$1,395,946	1922	5,250,556	$256,432
1919	9,140,673	928,291	1923	2,290,905	130,213
1920	3,783,409	306,899	1924	2,988,039	142,626
1921	3,582,933	217,491			

Brass and bronze exported from the United States in 1924

	Pounds	Value
Scrap and old	58,588,467	$5,352,197
Ingots, bars, rods, plates, and sheets	4,529,257	740,993
Pipes and tubes	2,058,016	488,215
Pipe fittings, valves, faucets, etc	2,897,303	1,617,364
Builders' hardware of brass or bronze	405,747	350,505
Wire of brass or bronze	883,831	289,147
Other brass manufactures	5,074,891	2,693,525
Other bronze manufactures	1,646,039	860,290
	76,083,551	12,392,236

Unmanufactured brass exported from the United States, 1918–1924

[Ingots, bars, rods, plates, and sheets]

Year	Pounds	Value	Year	Pounds	Value
1918	30,989,717	$9,522,934	1922	3,660,340	$635,449
1919	7,770,671	2,310,561	1923	3,465,739	703,503
1920	5,810,733	1,671,608	1924	4,529,257	740,993
1921	2,874,762	741,110			

CONSUMPTION

The refined new copper withdrawn from the total year's supply on domestic account in 1924 was 1,355,000,000 pounds; in 1923 it was 1,300,000,000 pounds. The method employed in determining the quantity of copper retained for consumption is shown in the following table, which does not include stocks of copper held by consumers:

New refined copper withdrawn from total year's supply on domestic account, 1919–1924, in pounds

	1919	1920	1921
Total supply of new copper	1,805,306,801	1,634,908,644	1,020,027,096
Stock at beginning of year	180,000,000	631,000,000	659,000,000
Total available supply	1,985,306,801	2,265,908,644	1,679,027,096
Copper exported [a]	439,835,229	553,070,086	609,038,352
Stock at end of year	631,000,000	659,000,000	459,000,000
	1,070,835,229	1,212,070,086	1,068,038,352
Withdrawn on domestic account	914,471,572	1,053,838,558	610,988,744

	1922	1923	1924
Total supply of new copper	1,358,659,101	2,140,546,843	2,405,985,978
Stock at beginning of year	459,000,000	216,000,000	264,000,000
Total available supply	1,817,659,101	2,356,546,843	2,669,985,978
Copper exported [a]	705,025,268	[b] 792,073,512	[b] 1,072,243,414
Stock at end of year	216,000,000	264,000,000	243,000,000
	921,025,268	1,056,073,512	1,315,243,414
Withdrawn on domestic account	896,633,833	1,300,473,331	1,354,742,564

[a] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.
[b] Exclusive of small quantity of unrefined black blister for which figures are not separable from those for ore and concentrates.

Adding the 776,600,000 pounds of secondary copper and copper in alloys produced during the year to the 1,354,700,000 pounds of new refined copper withdrawn on domestic account gives a total of about 2,131,300,000 pounds of new and old copper that was available for domestic consumption. It will be seen from the method of calculation that the figures represent the quantity of new copper withdrawn from supply on domestic account and not actual domestic consumption, as no account is taken of consumers' stocks, figures for which are not available. Furthermore, much of the copper exported is in manufactured forms; consequently much of the copper bought on domestic account during any year is exported in manufactured forms at a later date. The available figures do not permit an accurate calculation of copper consumption.

USES

There are no data available showing the quantity of copper that entered the different industries.

The following table shows the copper cast in different forms in 1924. It will be noted that the total is not the same as the production of refined copper:

Copper cast in different forms in the United States in 1924

Form	Pounds	Percentage
Wire bars	1,470,000,000	61.95
Ingots	368,000,000	15.51
Cakes	255,000,000	10.75
Cathodes	194,000,000	8.17
Other forms	86,000,000	3.62
	2,373,000,000	100.00

PRICES

Reports to the Bureau of Mines from copper-selling agencies in the United States indicate that 2,620,000,000 pounds of copper was delivered to purchasers in 1924 at an average price of 13.1 cents a pound. In 1923 the agencies reported sales of 2,405,000,000 pounds at an average price of 14.71 cents.

Price per pound of copper, 1900–1924, in cents[5]

1900	16. 6	1907	20. 0	1914	13. 3	1921	12. 9
1901	16. 7	1908	13. 2	1915	17. 5	1922	13. 5
1902	12. 2	1909	13. 0	1916	24. 6	1923	14. 7
1903	13. 7	1910	12. 7	1917	27. 3	1924	13. 1
1904	12. 8	1911	12. 5	1918	24. 7		
1905	15. 6	1912	16. 5	1919	18. 6		
1906	19. 3	1913	15. 5	1920	18. 4		

The average price for the last 20 years was 17.705 cents, compared with 13.1 cents in 1924.

Average monthly prices at New York per pound of electrolytic copper, 1918–1924, in cents, as reported by the American Metal Market Co.

Month	1918	1919	1920	1921	1922	1923	1924
January	23. 50	20. 05	19. 02	12. 85	13. 60	14. 66	12. 59
February	23. 50	16. 91	18. 61	12. 79	12. 97	15. 50	12. 85
March	23. 50	15. 01	18. 36	12. 23	12. 84	16. 96	13. 65
April	23. 50	15. 40	18. 54	12. 54	12. 71	16. 81	13. 36
May	23. 50	16. 00	18. 28	12. 83	13. 29	15. 63	12. 93
June	23. 50	17. 65	17. 97	12. 76	13. 71	14. 88	12. 49
July	25. 89	21. 71	18. 61	12. 35	13. 90	14. 59	12. 57
August	26. 00	22. 22	18. 44	11. 76	13. 96	14. 05	13. 31
September	26. 00	21. 95	18. 04	12. 10	13. 88	13. 60	13. 08
October	26. 00	21. 50	16. 30	12. 75	13. 80	12. 81	13. 04
November	26. 00	19. 96	14. 39	13. 16	13. 79	12. 89	13. 70
December	25. 28	18. 48	13. 48	13. 67	14. 22	12. 98	14. 32
Average	24. 68	18. 90	17. 50	12. 65	13. 56	14. 61	13. 16

Average monthly quoted prices at New York per pound of electrolytic copper, 1918–1924, in cents, as reported by the Engineering and Mining Journal-Press

Month	1918	1919	1920	1921	1922	1923	1924
January	23. 50	(a)	18. 918	12. 597	13. 465	14. 510	12. 401
February	23. 50	16. 763	18. 569	12. 556	12. 864	15. 355	12. 708
March	23. 50	14. 856	18. 331	11. 976	12. 567	16. 832	13. 515
April	23. 50	15. 246	18. 660	12. 438	12. 573	16. 663	13. 206
May	23. 50	15. 864	18. 484	12. 742	13. 111	15. 440	12. 772
June	23. 50	17. 610	18. 065	12. 697	13. 575	14. 663	12. 327
July	25. 904	21. 604	18. 576	12. 170	13. 654	14. 321	12. 390
August	26. 00	22. 319	18. 346	11. 634	13. 723	13. 822	13. 221
September	26. 00	21. 755	18. 144	11. 948	13. 748	13. 323	12. 917
October	26. 00	21. 534	15. 934	12. 673	13. 632	12. 574	12. 933
November	26. 00	19. 758	14. 257	13. 035	13. 598	12. 727	13. 635
December	(a)	18. 295	13. 138	13. 555	14. 074	12. 823	14. 260
Average	24. 628	18. 691	17. 456	12. 502	13. 382	14. 421	13. 024

[a] No market.

[5] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1900 to 1903. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years average price all marketable grades.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By V. C. Heikes

PRODUCTION

The general improvement in mining resulted in an increase in the quantity of gold, copper, and lead, but not of silver and zinc, produced in Nevada in 1924. The combined value of these metals, however, was less than in 1923. Four mining companies published or reported to the Bureau of Mines dividends paid in 1924 amounting to $614,874.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1924

	Producers	Ore, tailings, etc	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	384	4,099,333	$4,505,686	9,411,379	73,805,323	20,060,041	11,002,910	$22,799,799
Increase or decrease from 1923	−5	+344,396	+282,577	−1,203,185	+6,601,041	+1,903,704	−3,163,640	−2,240,550
Total, 1904–1924		71,215,611	191,605,243	216,578,970	1,138,180,437	276,333,199	200,272,630	582,617,318

[a] Includes placer production.

ORE

In 1924 the quantity of ore, tailings, etc., sold or treated in Nevada increased 8 per cent. The quantity of copper ore mined was greatest; dry gold and silver ore followed. The total value of metals in the ores, tailings, etc., was as follows: Dry gold ore, $1,584,983; dry gold and silver ore, $2,100,866; dry silver ore, $5,665,454; copper ore, $10,345,059; lead ore, $1,619,268; zinc ore, $1,755; copper-lead ore, $1,333; lead-zinc ore, $1,453,346. The placer output, valued at $27,735, makes the total for the State $22,799,799.

Ore and metals produced in Nevada in 1924

Source	Producers	Ore, tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	152	[a] 139,041	2.96	70,067.65	32.15	148,830	1.58
Dry gold and silver ore	18	[b] 524,248	11.15	48,099.53	22.07	1,651,347	17.55
Dry silver ore	85	[c] 403,190	8.58	63,460.37	29.11	6,202,682	65.91
Copper ore	9	3,505,301	74.59	32,314.93	14.83	106,614	1.13
Lead ore	94	[d] 81,202	1.73	1,995.82	.91	1,093,429	11.62
Zinc ore	1	41					
Copper-lead ore	2	3		.05		1,786	.02
Lead-zinc ore	9	46,307	.99	700.24	.32	206,145	2.19
Total deep mines		4,699,333	100.00	216,638.59	99.39	9,410,833	100.00
Total placers	36			1,323.97	.61	546	
		4,699,333	100.00	217,962.56	100.00	9,411,379	100.00

[a] Includes 14,987 tons of tailings, 297 tons of sweepings, and 5,839 tons of arsenical speiss
[b] Includes 1,200 tons of tailings.
[c] Includes 25,127 tons of tailings.
[d] Includes 650 tons of tailings and 46 tons of slag.

Ore and metals produced in Nevada in 1924—Continued

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	176,859	0.24	170,890	0.85		
Dry gold and silver ore	1,001		333			
Dry silver ore	125,323	.17	2,267,478	11.31		
Copper ore	[c]73,325,336	99.35				
Lead ore	154,363	.21	10,314,895	51.42		
Zinc ore					27,000	0.25
Copper-lead ore	489		893			
Lead-zinc ore	21,952	.03	7,305,552	36.42	10,975,910	99.75
	[c]73,805,323	100.00	20,060,041	100.00	11,002,910	100.00

[c] Includes 212,654 pounds of copper leached from ore in place and 108,309 pounds from mine water precipitates.

GOLD ORE

The gold ores, largely dry and siliceous, were mined by 152 producers in 1924, compared with 128 producers in 1923. These ores, tailings, etc., averaged $10.42 in gold and 1.07 ounces of silver to the ton, and 0.06 per cent of copper and 0.06 per cent of lead, and had an average value of $11.40 a ton. Nye County had the largest number of gold-ore producers—26—who reported 20,248 tons, mainly from the Round Mountain and Manhattan districts. Elko County, with only 8 producers of gold ore, had the greatest output—65,613 tons—nearly all of which came from the Jarbidge district. The largest producer of gold ore was the Elkoro mine at Jarbidge, followed by the Flowery mines at Virginia City, the Bluster mine at Jarbidge, the Round Mountain Mining Co. at Round Mountain, the Consolidated Virginia at Virginia City, and the White Caps at Manhattan. At Eureka the old slag dump of the Richmond-Eureka smelter produced 5,839 tons of speiss, yielding gold, silver, copper, and lead.

Dry gold ore, tailings, etc., sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Clark	1,644	1,429.56	2,952	1,789	25,226
Douglas	122	91.29	91		
Elko	[a]65,613	28,313.63	64,318		
Esmeralda	11,514	12,144.90	12,778	17,553	2,878
Eureka	[b]5,841	919.52	8,783	155,861	137,608
Humboldt	1,076	1,043.88	6,861		3,204
Lander	85	83.26	139		
Lyon	[c]2,696	1,001.86	5,697		
Mineral	470	487.26	1,032	1,656	1,974
Nye	20,248	14,377.53	7,466		
Ormsby	[d]60	13.63	122		
Pershing	[e]1,242	2,346.64	2,439		
Storey	[f]28,195	7,432.65	35,952		
Washoe	214	360.37	155		
White Pine	21	21.67	45		
	139,041	70,067.65	148,830	176,859	170,890

[a] Includes 12,000 tons of tailings.
[b] Includes 5,839 tons of arsenical speiss.
[c] Includes 1,910 tons of tailings.
[d] All tailings.
[e] Includes 297 tons of sweepings.
[f] Includes 1,017 tons of tailings.

GOLD AND SILVER ORES

Gold and silver ores were mined in eight counties by 18 producers. The average of the ore and tailings was $1.90 in gold and 3.15 ounces of silver to the ton. Four producers from Storey County reported 519,230 tons mined in the Comstock district.

Dry gold and silver ore and tailings sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	3	1.76	79		
Esmeralda	457	86.59	4,119		
Humboldt	1,052	656.29	21,592	281	333
Lyon	177	78.80	2,960		
Mineral	439	775.00	35,128		
Nye	90	69.89	1,897		
Pershing	[a] 2,800	233.53	5,056		
Storey	[b] 519,230	46,197.67	1,580,516	720	
	524,248	48,099.53	1,651,347	1,001	333

[a] Includes 100 tons of tailings. [b] Includes 1,100 tons of tailings.

SILVER ORE

The output of siliceous silver ore was mined by 85 producers. The average of the ore and tailings was $3.25 in gold and 15.38 ounces of silver to the ton, and 0.02 per cent of copper and 0.28 per cent of lead. The Tonopah district, in Nye and Esmeralda Counties, was the largest producer of silver ore and was credited with 285,707 tons, produced from 13 properties.

Dry silver ore and tailings sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	8	3.45	486		
Esmeralda	7,650	837.03	101,080	466	
Eureka	350	33.12	9,656	143	1,742
Humboldt	182	6.55	6,799	73	1,159
Lander	35,506	888.79	446,889	22,620	265,717
Lincoln	[a] 43,660	2,371.08	266,407	101,393	1,997,071
Lyon	31	8.79	807		
Mineral	3,676	83.87	24,278		
Nye	282,373	55,740.25	4,996,517		
Pershing	[b] 29,548	3,450.51	341,841	390	
Storey	3	5.14	224		
Washoe	126	16.78	4,377	115	731
White Pine	77	15.01	3,321	123	1,058
	403,190	63,460.37	6,202,682	125,323	2,267,478

[a] Includes 24,492 tons of tailings. [b] Includes 635 tons of tailings.

COPPER ORE

There were nine producers of copper ore in Nevada in 1924. The ore averaged 19 cents in gold and 0.03 ounce of silver to the ton and 1.04 per cent of copper; its average value was $2.95 in metals a ton. The Nevada Consolidated Copper Co. in the Robinson district, White Pine County, was the chief producer.

Copper ore sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Elko	32	----------	----------	11,928
Esmeralda	11	15.00	51	1,009
Lander	160	----------	45	17,032
Lyon	94	3.00	162	10,938
Washoe	105	25.95	295	8,062
White Pine	3,504,899	32,270.98	106,061	73,276,367
	3,505,301	32,314.93	106,614	[a] 73,325,336

[a] Includes 212,654 pounds of copper leached from ore in place and 108,309 pounds from mine water precipitates.

LEAD ORE AND COPPER-LEAD ORE

In 1924 lead ore was produced in Nevada at 94 mines, compared with 95 in 1923. The average content of the ore, tailings, etc., was 51 cents in gold and 13.47 ounces of silver to the ton, and 0.095 per cent of copper and 6.35 per cent of lead; the average value was $19.94 in metals a ton.

The output of copper-lead ore was reported by two producers. This ore had an average content of 34 cents in gold and 595.33 ounces of silver to the ton, and 8.15 per cent of copper and 14.88 per cent of lead; its average value was $444.33 in metals a ton.

Lead ore, tailings, etc., sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	90	8.36	4,592	129	37,803
Clark	3,070	409.03	46,271	21,468	2,647,134
Elko	[a] 4,707	16.44	72,043	9,058	1,553,842
Esmeralda	150	15.76	3,299	366	104,796
Eureka	13,835	559.06	30,975	4,340	1,637,577
Lander	30,940	125.45	497,336	33,754	265,713
Lincoln	2,812	120.36	28,046	21,456	656,304
Mineral	425	591.96	43,516	70	94,094
Nye	183	41.79	23,484	1,694	83,201
Ormsby	12	.12	540	----------	6,481
Pershing	117	.87	2,795	1,806	32,815
Washoe	[b] 13,731	26.54	302,268	47,078	924,663
White Pine	11,130	80.08	38,264	13,174	2,270,472
	81,202	1,995.82	1,093,429	154,363	10,314,895

[a] Includes 46 tons of slag

[b] Includes 650 tons of tailings.

ZINC ORE AND LEAD-ZINC ORE

The output of zinc ore was reported by one producer in the Yellow Pine district, Clark County.

Lead-zinc ore was produced from nine mines—in the Yellow Pine district, Clark County; the Pioche district, Lincoln County; and the Robinson district, White Pine County. The ore yielded an average of 31 cents in gold and 4.45 ounces of silver to the ton, and 0.02 per cent of copper, 7.89 per cent of lead, and 11.85 per cent of zinc, valued in all at $31.39 a ton. Most of the lead-zinc ore came from the Combined Metals mine in Lincoln County, and from the Rover mine (Yellow Pine Mining Co.) in Clark County.

Lead-zinc ore sold or treated in Nevada in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	18,395		77,959		5,092,411	7,882,042
Lincoln	27,809	692.87	126,254	21,610	2,198,149	3,074,843
White Pine	103	7.37	1,832	342	14,992	19,025
	46,307	700.24	206,145	21,952	7,305,552	10,975,910

The following table gives the zinc ore, lead-zinc ore, and concentrates produced from 1921 to 1924, with the average zinc content (assay) and the recovered zinc:

Zinc ore, lead-zinc ore, and concentrates (as marketed from Nevada mines and mills) sold to smelters, 1921–1924

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
1921					
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized lead-zinc ore	Clark	139	81,643	29.37	69,397
1922					
Oxidized zinc ore	Clark and White Pine	1,158	884,308	38.18	661,466
Oxidized lead-zinc ore	Clark and Lander	140	94,260	33.66	80,104
Concentrates	Clark and Mineral	2,763	2,208,400	39.96	1,877,140
		4,061	3,186,968	39.24	2,618,710
1923					
Oxidized zinc ore	Clark and White Pine	4,178	4,011,945	48.01	3,389,219
Oxidized lead-zinc ore	Clark	3,677	2,509,358	34.12	2,118,932
Sulphide zinc ore	do	190	162,970	42.89	130,376
Sulphide lead-zinc ore	Clark and Lincoln	8,604	3,342,005	19.42	2,838,177
Concentrates	Clark and White Pine	8,088	6,760,857	41.80	5,689,846
		24,737	16,787,135	33.93	14,166,550
1924					
Oxidized zinc ore	Clark	41	34,999	42.68	27,000
Oxidized lead-zinc ore	do	10,775	6,453,064	29.94	5,480,304
Sulphide lead-zinc ore	Lincoln	970	330,845	17.05	248,134
Concentrates	Clark, Lincoln, and White Pine	9,553	6,697,029	35.05	5,247,472
		21,339	13,515,937	31.67	11,002,910

METALLURGIC INDUSTRY

Sixty milling plants treated Nevada ore in 1924. Of these, 22 used the amalgamation process, 10 concentration (6 had flotation units), 19 cyanidation, 6 concentration and cyanidation, and 3 amalgamation and concentration.

About 584 pounds of mercury were purchased for amalgamation plants, and 2,703,706 pounds of potassium and sodium cyanide were used in other mills.

Gold and silver produced at Nevada mills in 1924

County	Ore (short tons)	Bullion (fine ounces) recovered by—				Total value
		Amalgamation		Cyanidation		
		Gold	Silver	Gold	Silver	
Clark	[a] 1,596	325.11	122	465.16	1,474	$17,405
Douglas	11	30.24	22			640
Elko	53,485	59.94	44	[b] 27,849.18	[b] 55,984	614,472
Esmeralda	[c] 8,076	46.73	15	5,192.11	82,751	163,749
Eureka	270			1.12	5,960	4,016
Humboldt	[d] 763	397.10	144			8,306
Lander	[e] 32,434	47.26	28	651.99	331,162	236,352
Lyon	745	316.33	240	[f] 625.32	[f] 6,124	23,730
Mineral	[g] 3,898	247.66	141	97.06	20,973	21,272
Nye	[h] 295,789	9,927.88	6,190	59,006.05	4,924,029	4,728,238
Ormsby	(i)	[i] 13.63	[i] 122			364
Pershing	[j] 31,681	2,213.96	1,283	[k] 3,666.32	[k] 330,558	343,889
Storey	[l] 541,985	914.19	1,701	[m] 50,768.30	[m] 1,583,687	2,130,582
Washoe	214	360.37	155			7,553
White Pine	19	16.31	44			367
	970,966	14,916.71	10,251	148,322.61	7,342,702	8,300,935

[a] Also yielded 47 tons of lead concentrate.
[b] Includes bullion from 12,000 tons of old tailings.
[c] Also yielded 3 tons of lead concentrate.
[d] Also yielded 1 ton of siliceous concentrate.
[e] Also yielded 395 tons of lead concentrate.
[f] Includes bullion from 1,910 tons of old tailings.
[g] Also yielded 3 tons of lead concentrate.
[h] Also yielded 11 tons of siliceous concentrate.
[i] Bullion from 60 tons of old tailings.
[j] Also yielded 4 tons of siliceous concentrate.
[k] Includes bullion from 220 tons of sweepings and 35 tons of tailings.
[l] Also yielded 23 tons of siliceous concentrate.
[m] Includes bullion from 716 tons of old tailings

The output of milling ores was 4,482,749 tons, of which 970,966 tons were treated by amalgamation or cyanidation and 3,511,783 tons by concentration followed by smelting. The ore (951,054 tons), tailings, and sweepings treated by cyanidation yielded an average of $3.17 in gold and 7.60 ounces of silver to the ton. The ore (19,912 tons) and tailings amalgamated yielded bullion averaging $15.39 in gold and 0.512 ounce of silver to the ton. Nearly 75 per cent of the total ore was of concentrating grade and produced concentrate averaging $27.82 a ton in metals.

Mine production of gold, silver, copper, lead, and zinc from Nevada concentrates in 1924

By counties

	Ore to concentrating mills[a]	Concentrates	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Churchill	3	1	2.14	97		591		$156
Clark	7,620	7,667	449.82	79,001	1,429	2,605,821	2,401,738	426,996
Elko	400	44		449		47,720		4,119
Esmeralda		3	64.15	24	10	569		1,388
Eureka	11,996	1,007	57.06	17,522	193	1,102,511		101,145
Humboldt	1,052	167	656.54	21,595	281	333		28,104
Lander	30,882	2,465	181.92	567,416	36,643	310,959		413,607
Lincoln	27,724	12,478	755.89	126,623	21,610	2,161,800	2,826,709	459,974
Mineral		3	2.40	67		1,974		253
Nye	35	19	47.50	564		5,716		1,817
Pershing		4	23.27	446				780
Storey		41	128.97	2,300	¶20			4,302
Washoe	13,068	1,651	25.81	300,396	46,932	915,239		281,165
White Pine	3,419,003	371,044	31,618.78	103,603	65,541,288	14,992	19,025	9,311,376
	[a]3,511,783	396,594	34,014.25	1,220,103	65,649,106	7,168,225	5,247,472	11,035,182

By kinds of concentrates

Dry and siliceous	223	855.94	24,385	1,001	333		$34,190
Copper	371,000	31,611.41	101,771	65,540,946			9,307,517
Lead	15,818	1,439.78	1,064,944	100,735	6,818,212		1,301,928
Zinc	5,216		245		956	2,420,763	157,589
Lead-zinc	4,337	107.12	28,758	6,424	348,724	2,826,709	233,958

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Dry and siliceous	223	3.838	109.35	0.22	0.07		$153.32
Copper	371,000	.085	.27	8.83			25.09
Lead	15,818	.091	67.32	.32	21.55		82.31
Zinc	5,216		.05			23.21	30.21
Lead-zinc	4,337	.025	6.63	.07	4.02	32.59	53.94
	396,594	.086	3.08	8.28	.90	.66	27.82

[a] Tailings also were concentrated.

The oxidized lead ore, largely carbonates, of smelting grade decreased from 21,850 tons in 1923 to 20,224 tons in 1924 and averaged $1.20 in gold, 11.40 ounces of silver, 3.23 pounds of copper, 338.37 pounds of lead, and $36.32 in total value to the ton. The sulphide lead ores of smelting grade (3,013 tons) averaged $3.72 in gold, 17.63 ounces of silver, 2.78 pounds of copper, 351.91 pounds of lead, and $44.04 in total value to the ton. The total production of copper-lead ores decreased from 330 tons in 1923 to 3 tons in 1924, all of which in 1924 was oxidized or carbonate ore shipped directly to smelters and averaged 34 cents in gold, 595.33 ounces of silver, 163 pounds of copper, 297.67 pounds of lead, and $444.33 in total value to the ton. Of the lead-zinc ore produced (46,307 tons) only 11,745 tons was first-class shipping ore. All the zinc ore produced was shipped directly to the smelter.

Mine production of gold, silver, copper, lead, and zinc from Nevada crude ore shipped to smelters in 1924

By counties

	Ore	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Churchill	98	11.43	5,060	129	37,212		$6,620
Clark	13,934	598.50	46,585	21,828	5,158,950	5,507,304	817,134
Douglas	111	61.06	69				1,308
Elko	4,421	420.95	79,699	20,082	1,490,775		183,993
Esmeralda	11,706	7,796.29	38,537	19,384	107,105		198,091
Eureka	1,921	567.94	17,154	4,290	536,808		66,740
Humboldt	495	653.08	13,513	73	4,363		22,913
Lander	3,376	216.37	47,453	37,061	220,960		58,799
Lincoln	22,067	162.64	85,099	45,870	1,785,498	248,134	225,356
Lyon	343	150.80	3,262	10,938			6,736
Mineral	1,112	1,590.97	82,773	1,726	94,094		96,100
Nye	7,070	1,248.03	98,581	1,694	77,485		98,269
Ormsby	12	.12	540		6,481		883
Pershing	1,094	121.29	12,833	2,196	32,815		14,018
Storey	3,226	1,464.73	25,505				47,367
Washoe	244	43.46	6,544	8,293	10,155		7,182
White Pine	97,208	760.02	45,876	7,427,755	2,271,530		1,201,206
	168,438	15,867.68	609,083	7,601,319	11,834,231	5,755,438	3,052,715

By kinds of ore

Dry and siliceous	47,011	13,439.43	314,371	63,656	1,308,238		$601,445
Copper	86,401	703.52	4,843	7,463,427			995,497
Lead	23,237	1,706.95	283,708	73,749	7,903,454		867,307
Zinc	41					27,000	1,755
Copper-lead	3	.06	1,786	487	893		1,333
Lead-zinc	11,745	17.72	4,375		2,621,646	5,728,438	585,378

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Dry and siliceous	47,011	0.286	6.69	0.07	1.39		$12.79
Copper:							
Oxidized	35,617	.010	.08	2.17			5.93
Sulphide	50,784	.007	.04	5.83			15.44
Lead:							
Oxidized	20,224	.058	11.40	.16	16.92		36.32
Sulphide	3,013	.180	17.63	.14	17.60		44.04
Zinc: Oxidized	41					32.93	42.80
Copper-lead: Oxidized	3	.017	595.33	8.15	14.88		444.33
Lead-zinc:							
Oxidized	10,775				11.65	25.43	51.70
Sulphide	970	.018	4.51		5.75	12.79	29.22
	168,438	.094	3.62	2.26	3.51	1.71	18.12

GOLD

The mine production of gold in Nevada increased from $4,223,109 in 1923 to $4,505,686 in 1924. Ore was treated by amalgamation in 13 counties and gold amalgam by one plant re-treating tailings in Ormsby County. Cyanidation of ore and tailings was reported in 10 counties. By these two methods of treatment $3,374,456 in gold was produced from 970,966 tons of ore, 14,721 tons of old tailings, and 220 tons of sweepings. Most of the placer gold in 1924 was obtained by hydraulic work in the Round Mountain district, Nye County, and by drift mining at Manhattan and in the Battle Mountain district, Lander County.

Seven producers supplied nearly 75 per cent of the total gold in 1924. Their properties, which yielded more than 8,500 ounces each, were the United Comstock in the Comstock district, the Nevada Consolidated at Ely, the Tonopah Extension at Tonopah, the Elkoro at Jarbidge, the Tonopah Belmont at Tonopah, the Round Mountain Mining Co. at Round Mountain, and the West End at Tonopah.

SILVER

In 1924 the quantity of silver decreased 11 per cent and the value 28 per cent, owing to the decrease in price. The largest decreases in quantity were in Mineral, Pershing, and Esmeralda Counties. Gold and silver milling plants in Nye County were credited with 4,930,219 ounces, most of which (4,924,029 ounces) was recovered by cyanidation from ores treated principally in the Tonopah district. In the Comstock district, Storey County, 1,583,687 ounces of silver were recovered by cyanidation, and in the Rochester district, Pershing County, 322,975 ounces of silver were recovered by the same process. Concentrates yielded 1,220,103 ounces of silver, against 1,134,192 ounces in 1923. Lead concentrates contained 1,064,944 ounces of silver, an average of 67.32 ounces per ton, against 1,021,431 ounces, an average of 150.18 ounces, in 1923.

Seven properties yielded more than 78 per cent of the total silver: The Tonopah Extension at Tonopah; the United Comstock in the Comstock district; the Tonopah Belmont, West End Consolidated, and Tonopah Mining, all at Tonopah; the Betty O'Neal near Battle Mountain; and the Consolidated Cortez at Cortez, Lander County.

COPPER

In 1924 the mine production of copper in Nevada increased 10 per cent in quantity, but the value decreased 2 per cent ($210,532) owing to the decreased price. The mine of the Nevada Consolidated Copper Co. at Ely, White Pine County, made the largest output, producing copper at the average rate of nearly 6,000,000 pounds a month. Shipments of ore were made throughout the year from the property of the Consolidated Coppermines to the smelter at McGill. The speiss shipped from the old slag dump of the Richmond-Eureka smelter contained some copper.

LEAD

The mine production of lead in Nevada in 1924 increased 10 per cent in quantity. Nearly 36 per cent of the lead was derived from concentrates of milling ore, and 59 per cent from crude ore shipped directly to smelters. Lead concentrates (carbonates and sulphides) shipped to smelters contained 6,818,212 pounds of lead, against 4,529,964 pounds in 1923, and averaged 21.55 per cent of lead, against 33.30 per cent in 1923. The total crude ore of shipping grade contained 11,834,231 pounds of lead, against 10,333,896 pounds in 1923. Oxidized lead ore shipped to smelters contained 6,843,149 pounds of

lead, and sulphide ore 1,060,305 pounds, against 4,894,825 pounds and 1,213,009 pounds, respectively, in 1923. Copper-lead ore (all of which was oxidized ore) of shipping grade produced 893 pounds of lead. The oxidized lead-zinc ore of smelting grade produced 2,510,142 pounds of lead and the sulphide ore 111,504 pounds.

More than 80 per cent of the lead came from eight mines. The property of the Yellowpine Mining Co. in the Yellowpine district, Clark County, produced more than three times as much lead as any other mine in Nevada; there followed in order the Combined Metals, near Pioche, Lincoln County; the Ward in the Ward district, White Pine County; the Eureka Holly, Eureka County; the Virginia Louise, Lincoln County; the Leadville Mines Co., Washoe County; Prince Consolidated tailings, Lincoln County; and the Spruce Monarch, Elko County.

ZINC

The Yellowpine district, Clark County, produced the largest part of the zinc output; the Pioche district, Lincoln County, came second. The Yellowpine Mining Co. was the largest producer, and the Combined Metals Reduction was next.

MINING INDUSTRY

Although silver no longer commands the price it did when the Pittman Act was in force, Nevada miners were active in 1924, opening new deposits of ore and finding old ones worth exploiting. The mines in the old camp of Hamilton, in White Pine County, were thoroughly prospected by Tonopah mine operators. Large deposits of low-grade silver and gold ore in the Comstock district, Storey County, which had been extensively prospected, were mined, bringing the district again into prominence as a silver producer; it ranked second to Tonopah for 1924 in the output of gold and silver. Gilbert, in the Desert mining district 29 miles west of Tonopah, was the scene of much activity. In the Mason Valley district the mines were being prepared for production with the possible opening of the copper smelter at Thompson. The Nevada Consolidated at Ely nearly completed its new concentrator and increased the capacity of the crushing plant, the roasting and converting departments of its smelter, and the power plant.

Arsenical ores were found in many districts in Nevada, and nearly 12,000 tons of ore and arsenical speiss found a ready market during the period of high prices for arsenic, which began to decline in June.

Efforts were made to reestablish the tungsten industry in Nevada. Lessees produced scheelite near Mill City, Humboldt County, and a mill was ready to run in the Nightingale Mountains, east of Lake Winnemucca. Near Pioche and 20 miles east of Mina tungsten deposits were under development.

REVIEW BY COUNTIES

GENERAL FEATURES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1924, by counties

County	Gold					Silver[a]	
	Placers		Deep mines		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Churchill			13.55	$280	$280	5,157	$3,455
Clark			1,838.59	38,007	38,007	127,182	85,212
Douglas	9.48	$196	91.29	1,887	2,083	92	62
Elko			28,330.05	585,634	585,634	136,361	91,362
Esmeralda	14.85	307	13,099.27	270,786	271,093	121,336	81,295
Eureka			1,511.72	31,250	31,250	49,414	33,107
Humboldt	31.20	645	1,706.72	35,281	35,926	35,254	23,620
Lander	194.90	4,029	1,097.53	22,688	26,717	946,086	633,878
Lincoln			3,184.33	65,826	65,826	420,943	282,032
Lyon			1,092.45	22,583	22,583	9,626	6,449
Mineral	8.37	173	1,938.09	40,064	40,237	103,956	69,650
Nye	923.14	19,083	70,229.47	1,451,772	1,470,855	5,029,825	3,369,983
Ormsby			13.74	284	284	662	443
Pershing	99.75	2,062	6,031.59	124,684	126,746	352,168	235,953
Storey			53,635.44	1,108,743	1,108,743	1,616,692	1,083,184
Washoe			429.62	8,881	8,881	307,095	205,754
White Pine	42.28	874	32,395.14	669,667	670,541	149,530	100,185
Total, 1923	1,323.97	27,369	216,638.59	4,478,317	4,505,686	9,411,379	6,305,624
	3,941.83	81,485	200,351.06	4,141,624	4,223,109	10,614,564	8,703,942

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	129	$17	37,803	$3,024			$6,776
Clark	23,257	3,047	7,764,771	621,182	7,909,042	$514,088	1,261,536
Douglas							2,145
Elko	20,986	2,749	1,553,842	124,307			804,052
Esmeralda	19,394	2,541	107,674	8,614			363,543
Eureka	160,344	21,005	1,776,927	142,154			227,516
Humboldt	354	46	4,695	376			59,968
Lander	73,704	9,655	531,919	42,554			712,804
Lincoln	144,650	18,949	4,851,928	388,154	3,074,843	199,865	954,826
Lyon	10,938	1,433					30,465
Mineral	1,726	226	96,068	7,685			117,798
Nye	1,694	222	83,201	6,656			4,847,716
Ormsby			6,481	518			1,245
Pershing	2,196	288	32,815	2,625			365,612
Storey	720	94					2,192,021
Washoe	55,225	7,234	925,394	74,032			295,901
White Pine	73,290,006	9,600,991	2,286,522	182,922	19,025	1,236	10,555,875
Total, 1923	73,805,323	9,668,497	20,060,041	1,604,803	11,002,910	715,189	22,799,799
	67,204,282	9,879,029	18,156,337	1,270,944	14,166,550	963,325	25,040,349

[a] Includes placer production.

Ore sold or treated, deep mines producing, and average value of ore in Nevada, 1923–24, by counties

County	Ore, tailings, etc., sold or treated 1924 (short tons)		Number of deep mines producing		Average value per ton[a]		Average value per ton in gold and silver[a]	
	Total	Increase or decrease	1923	1924	1923	1924	1923	1924
Churchill	101	−1,003	11	10	$30.15	$67.09	$24.88	$36.98
Clark	23,150	+7,090	20	16	47.19	54.49	3.28	5.32
Douglas	122	+65	5	3	23.28	15.97	21.84	15.97
Elko	70,352	+26,840	28	23	11.87	11.43	9.91	9.62
Esmeralda	19,782	−2,292	27	41	24.92	18.36	24.74	17.80
Eureka	20,026	−7,048	15	11	12.95	11.36	5.82	3.21
Humboldt	2,310	+1,906	17	14	82.18	25.68	79.45	25.50
Lander	66,692	+13,406	16	15	15.43	10.63	14.19	9.84
Lincoln	74,283	−18,862	10	13	14.41	12.85	6.71	4.68
Lyon	2,998	+1,535	11	12	18.49	10.16	15.09	9.68
Mineral	5,010	−134,919	35	35	6.86	23.48	4.16	21.90
Nye	302,894	−112,845	65	54	14.18	15.94	14.18	15.92
Ormsby	72	+17	3	2	11.85	17.29	11.64	10.10
Pershing	33,707	−66,076	27	34	7.37	10.78	7.34	10.70
Storey	547,428	−36,809	21	24	3.54	4.00	3.54	4.00
Washoe	14,176	+1,865	17	15	19.95	20.87	15.06	15.14
White Pine	3,516,230	+671,526	26	26	3.73	3.00	.26	.22
	4,699,333	+344,396	354	348	5.73	4.85	2.95	2.29

[a] Placer product excluded.

Production of placer mines in Nevada, 1923–24, by counties

County	1923						1924					
	Mines			Gold	Silver (fine ounces)	Total value	Mines			Gold	Silver (fine ounces)	Total value
	Hydraulic	Drift	Dredge				Hydraulic	Drift	Dredge			
Churchill	1			$253	3	$255						
Douglas	1			146	1	147	2			$196	1	$197
Esmeralda	3			921	6	926	1			307	9	313
Eureka	2			1,248	4	1,251						
Humboldt							2			645	2	646
Lander	5			6,619	44	6,655	6			4,029	27	4,047
Lyon			1	31,835	670	32,385						
Mineral	1			42	1	43	1			173	2	174
Nye	[a] 15	1		37,950	1,016	38,783	[a] 15			19,083	461	19,392
Pershing	4			1,027	26	1,048	7	1		2,062	37	2,087
White Pine	1			1,444	12	1,454	1			874	7	879
	33	1	1	81,485	1,783	82,947	35	1		27,369	546	27,735

[a] Part of operations drifting and sluicing.

CHURCHILL COUNTY

Alpine district.—Gold and silver ore mined from the Grand Prize claim was hauled 93 miles by truck to the sampling works at Hazen.

Broken Hills district.—Lead-silver ore was reported mined at the Silver Trailer property and sold to the sampling works at Hazen.

Fairview district.—Three mine operators in the Fairview district reported the output of lead ore and gold-silver ore. Most of the output of 70 tons came from the mine of the Chalk Mountain Silver-Lead Mines Co., which is opened by a vertical shaft 100 feet deep and has 1,000 feet of drifts.

Holy Cross district.—Silver ore from the Last Hope property averaged 113 ounces of silver and $9 in gold to the ton.

Hot Springs district (Eagleville).—One lot of gold ore for an experimental test was shipped from the Highland group, which is developed by a vertical shaft 300 feet deep and a tunnel 700 feet long. A 50-ton cyanidation plant, to treat about 10,000 tons of developed ore averaging about $20 a ton in gold, was under construction. Most of the mining equipment for the Highland group was moved from Masonic, Calif., in February, 1924.

Silver Range district.—Prospectors in the Silver Range district shipped lead ore containing gold and silver.

CLARK COUNTY

In Clark County there were 16 producers, four less than in 1923, and the yield of ore and all metals except copper and zinc increased—ore from 16,060 to 23,150 tons, gold from $22,595 to $38,007, silver from 36,669 to 127,182 fine ounces, lead from 1,519,764 to 7,764,771 pounds, and total value from $757,946 to $1,261,536. The copper decreased from 24,005 to 23,257 pounds, and the zinc from 8,755,427 to 7,909,042 pounds.

Eldorado Canyon district.—Concentrate and gold and silver bullion were shipped from a lease on the Techatticup mine.

Searchlight district—Various lessees working the Duplex property and the Blossom mine produced gold bullion and concentrate.

Yellowpine district.—Thirteen producers in the Yellowpine district reported the output of 21,383 tons of ore. The same number of producers reported 14,758 tons in 1923. Most of the output in 1924 came from the property of the Yellowpine Mining Co. The total output of the district contained $145 in gold, 123,650 ounces of silver, 16,267 pounds of copper, 7,710,851 pounds of lead, and 7,909,042 pounds of zinc, valued in all at $1,216,077. The ore of shipping grade amounted to 13,763 tons and contained 7 ounces of gold, 45,691 ounces of silver, 16,267 pounds of copper, 5,128,582 pounds of lead, and 5,507,304 pounds of zinc. Lead concentrate and zinc concentrate were separated in the concentration mill of the Yellowpine Mining Co. The lead concentrate, amounting to 2,429 tons, contained 77,959 ounces of silver and 2,582,269 pounds of lead. The roasted zinc concentrate, of which there were 3,714 tons, contained 2,823,762 pounds of zinc, representing the assay content of the concentrate. The Bullion, Anchor, Milford, Yellowpine Extension, Ingomar, and Tiffen properties produced and shipped to lead and zinc smelters smaller lots of ore containing lead and zinc. The Potosi, Over, May Kirby, and Maiden Rock properties shipped lead ore only.

The Yellowpine property[1] produced 21,500 tons of ore at a cost of $6.88 a ton. Most of this ore was mined north of the porphyry dike in the north section of the mine, where a new ore deposit was discovered in 1923. At various places considerable prospecting was done; it cost $3.93 a foot by diamond drill, $1.59 by Turbro drill, and $2.37 by churn drill. On September 19 a fire destroyed the

[1] Yellowpine Mining Co. Ann. Rept. for 1924.

concentration mill, which had already treated 7,620 tons of ore at a cost of $1.89 a ton. From the ore, 4,866 tons of zinc concentrate, 325 tons of slimes, and 2,429 tons of lead concentrate were produced. The lead concentrate netted the company $68.88 a ton. The calciner treated all the zinc concentrate (4,866 tons) at a cost of $2.20 a ton, and produced 3,683 tons of calcined zinc concentrate, for which $11.86 a ton was received. All the lead ore is sold under contract to the American Smelting & Refining, Co. and the mixed lead-zinc ore to the Ozark Smelting & Mining Co. Dividends paid to stockholders in 1924 amounted to $160,000, a total of $2,884,000 to date.

DOUGLAS COUNTY

Buckskin district.—Two producers in the Buckskin district reported the output of $1,381 in gold and 70 ounces of silver. Part of this output came from a placer mine, but most of it was extracted from siliceous gold ore shipped from the Kennedy mine, at the west end of Smith Valley, to the Kennett smelter in California.

Pine Nut district.—The Zirn placer yielded one small lot of gold.

Silver Glance district.—A few tons of ore were treated in the five-stamp amalgamation mill of the Carson Valley Mining Co. Two cars of arsenic ore were shipped to Martinez, Calif., from an adjoining property.

ELKO COUNTY

In Elko County, the production of ore and all metals except copper increased in 1924, but there were five producers less than in 1923. The ore mined increased from 43,512 to 70,352 tons, gold from $348,752 to $585,634, silver from 100,513 to 136,361 fine ounces, lead from 1,134,465 to 1,553,842 pounds, and the total value from $516,609 to $804,052. Copper decreased from 40,976 to 20,986 pounds.

Delno district.—The Panther Mines Co., working a lead property 35 miles north of Montello, shipped 631 tons of lead-silver ore. The ore is oxidized and occurs in a bed between limestone and quartzite. An inclined shaft on the property is 650 feet deep.

Gold Circle district (Midas).—Mine operators in the Gold Circle district reported the output of 183 tons of ore, containing $9,531 in gold and 8,331 ounces of silver, valued together at $15,113, or $82.58 a ton. Part of the ore produced was shipped to the Mammoth smelter at Kennett, Calif.; the remainder was milled in the district and produced gold and silver bullion. The producers were the Red Hills Florence Mining Co., a lessee on the Queen mine, and the Regalia property

Island Mountain district.—The Gold Center property of the Hammond Exploration Co. was idle during 1924, but a small amount of sorted gold ore was sold to an ore dealer.

Jarbidge district.—Gold ore and considerable tailing were treated by cyanidation in two milling plants. Mining was done in the Long Hike and O. K. mines of the Elkoro Mines Co.,[2] in the property of the subsidiary Jarbidge Gold Mining Co. (Ltd.), and in one of the leased mines. A total of 49,827 tons of ore was milled,

[2] Yukon Gold Co. Ann. Rept. for 1924.

which yielded $554,663 in gold and silver, an average of $11.13 a ton. The total cost of mining and milling, excluding depreciation and development, was $245,141, or $4.92 a ton, leaving an operating profit of $309,522. In connection with current development work $76,222 was charged off, leaving an operating profit of $233,300. Development of leased properties cost $44,867.

Lone Mountain district.—The Rip Van Winkle mine, operated by the Alaska Improvement Co., produced two cars of lead-silver ore, which was shipped to the smelter.

Mud Springs district.—The property of the Marie Consolidated Mines Co. yielded 15 tons of lead-silver ore averaging about $40 a ton.

Railroad district.—Ore of smelting grade containing copper was produced from the Copper Belle claim, and old slag containing lead, a little copper, and silver was shipped to a Salt Lake smelter from an old smelter dump in the district.

Ruby Mountain Range district.—Three producers in the Ruby Mountain Range district reported the mining of 518 tons of ore, most of which was milled in the wet concentrator on the L. C. property. This new mill started in August and ran intermittently to the end of the year, producing lead concentrate containing silver, which, with lead ore from the Michigan mine, was hauled 43 miles to Tobar, on the Western Pacific Railroad, and shipped to the smelter. The American Beauty mine was worked by a lessee who produced several cars of lead ore.

Spruce Mountain district.—All the ore produced by five operators in the Spruce Mountain district, amounting to 3,333 tons, was of shipping grade and contained $210 in gold, 46,866 ounces of silver, 5,904 pounds of copper, and 1,016,927 pounds of lead, valued in all at $113,738, or $34.12 a ton. The Spruce Monarch mine was the largest producer, and shipments of lead-silver ore amounted to 2,752 tons. From the Black Forest property, worked by the same interests, 560 tons of oxidized lead ore were shipped to the smelter. The Ada H. mine of the Paramount Consolidated Mining Co. also produced lead ore.

Tecoma district.—Lead-silver ore averaging 8 ounces of silver to the ton and 18.2 per cent of lead was shipped to the smelter from the Jackson mine.

ESMERALDA COUNTY

The production in Esmeralda County showed increases in three metals—the gold increased from $170,966 to $271,093, copper from 2,626 to 19,394 pounds, and lead from 52,540 to 107,674 pounds. The ore decreased from 22,074 to 19,782 tons, silver from 458,530 to 121,336 fine ounces, and the total value from $551,025 to $363,543. There were 41 producers, 12 more than in 1923.

Columbia district.—Siliceous silver ore was shipped to the smelter at Kennett, Calif., from the Banner mine, near the old Columbus camp.

Desert district (Gilbert).—The discovery of high-grade gold ore in the Desert district caused excitement, but only a few lots were shipped. Some of this ore was sold to the custom cyanide plant of the Tonopah Mining Co. at Millers. The Gilbert Last Hope Gold

Mines Co. was expected to erect a cyanide mill on its property at Gilbert.

Goldfield district.—Lessees who worked in 12 of the old producing mines in the Goldfield district reported the output of 7,352 tons of ore. Most of this ore, 5,675 tons, was of shipping grade and the larger part was valuable to the copper smelter at Kennett, Calif. The ore contained 4,336.17 ounces of gold, 3,982 ounces of silver, and 17,901 pounds of copper. The ore shipped to cyanidation mills at Tonopah and Millers amounted to 1,677 tons and contained 2,700.26 ounces of gold and 947 ounces of silver. The most important shippers of siliceous gold ore, some of it from mine-waste dumps, were the lessees mining the Florence, Goldfield Consolidated, Jumbo Extension, Great Bend, Diamondfield Black Butte, Sandstorm Kendall, and Daisy properties. The Goldfield Deep Mines Co. continued sinking its shaft to a depth of 2,400 feet. The total development work of laterals and shaft sinking in 1924 amounted to 1,800 feet.

Gold Mountain (Divide) district.—Silver ore, amounting to 369 tons and valued at $12,852 for the silver and a little gold, was produced from the Tonopah Divide property [3] and hauled by truck to a cyanidation plant at Tonopah. All operations on the property in the Divide district were suspended temporarily and the force of miners increased in the Tonopah district, where additional mining claims were purchased from the Tonopah Midway Consolidated Co. Most of the ore from the Hasbrouck property was shipped to the smelter at Kennett, Calif., and part of it milled at Millers. The Divide Extension property also produced silver ore of milling grade.

Hornsilver district.—Gold-silver ore was shipped from the Orleans Hornsilver property to the cyanidation mills at Tonopah and Millers, and lower-grade siliceous ore to the copper smelter at Kennett, Calif. One small lot of silver-lead ore from the Nettie L. claim of the Nevada Silvermines Co. was shipped to a smelter in Utah.

Klondyke district.—Five operators in the Klondyke district reported mining 3,209 tons of ore, which contained $3,294 in gold, 23,964 ounces of silver, and 466 pounds of copper, valued at $19,411 in all, or $6.05 a ton. All but 30 tons of the ore, which went to Tonopah, was shipped to the copper smelter at Kennett, Calif. The producers were the Golden State, Marinette, Original Klondyke, Yukon Divide, and Crown Point properties.

Lida district (Tule Canyon).—Placer gold was produced by a prospector working in Tule Canyon.

Lone Mountain district.—The Mother Lode property, at the north end of Lone Mountain, shipped a car of silver ore to the smelter at Kennett, Calif. Some of the ore contained 100 ounces of silver to the ton.

Montezuma district.—Sulphide lead-silver ore was shipped by the Harmill Divide Co. from the Monitor mine, and a small lot of silver ore was shipped from a prospect in the district.

Palmetto district.—Gold-silver ore mined at the property of the Palmetto Consolidated (Inc.), 15 miles west of Lida, was hauled to Goldfield for shipment by railroad.

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[3] Tonopah Divide Mining Co. Ann. Rept. for 1924.

Silver Peak district.—Lessees at the Mary mine produced considerable siliceous ore containing gold and silver; some of it was shipped to the smelter at Kennett, Calif., and some to the Tonopah mills for treatment. Bullion and cyanide precipitate were shipped from ore treated in the mill at Silverpeak.

Tokop (Gold Mountain) district.—From the Fissure claim oxidized lead ore was shipped to a lead smelter. The ore was hauled northeast to Stonewall siding, on the Goldfield & Bullfrog Railroad.

Tonopah district.—Considerable siliceous silver ore was mined in the Tonopah district and credited to the Tonopah "76," West End Extension, and McKane 1,200-foot workings of the Tonopah Extension Co. Future production may increase from this (Esmeralda County) part of the district. Further information will be found under Nye County in which the district largely lies.

Windypah district.—Oxidized lead ore from the Whim claim of the Ruth group, 4 miles south of Palmetto near the California line, was shipped to a lead smelter near Salt Lake City. The claim has a shaft 85 feet deep. The shipping point is Goldfield, 50 miles from the mine.

EUREKA COUNTY

The number of producers in Eureka County decreased from 17 to 11, and the production of all metals except lead declined. Ore decreased from 27,074 to 20,026 tons, gold from $87,017 to $31,250, silver from 87,459 to 49,414 fine ounces, copper from 646,870 to 160,344 pounds, and the total value from $351,748 to $227,516. Lead increased from 1,398,929 to 1,776,927 pounds.

Eureka district.—Nine operators in the Eureka district produced ore and speiss from an old smelter dump amounting to 20,006 tons. The total output contained $30,548 in gold, 48,552 ounces of silver, 160,344 pounds of copper, and 1,776,927 pounds of lead, valued in all at $226,237 or $11.31 a ton. The speiss and some of the ore came from the Richmond-Eureka property. Considerable ore was milled in the wet concentration and flotation plant of the Eureka Holly property. Other producers were the Excelsior & Diamond, Eureka-Prince, Hamburg, Eureka-Nevada, and Williamsburg. The Richmond-Eureka Mining Co.[4] shipped 12,522 tons of speiss, part of which was stored at Palisade. Diamond drilling from the 900-foot level of the Locan shaft to locate the continuation of the ore bodies mined on the northeast side of the Ruby fault in early days was discontinued and the equipment removed.

Lynn district.—A small lot of material rich in gold was shipped to the smelter from the Lynn Big Six mine. Placer mines produced gold dust, most of which was sold or traded to merchants who did not report for 1924.

Safford district.—Siliceous silver ore was shipped to the copper smelter at Kennett, Calif., from the United Mines. The property is opened by a shaft 100 feet deep and has a tunnel 800 feet long and 200 feet of drifts. Palisade, 1½ miles from the mines, is the shipping station.

[4] United States Smelting, Refining & Mining Co. Nineteenth Ann Rept., for year ended Dec. 31, 1924.

HUMBOLDT COUNTY

Amos district (Slumbering Hills).—Lessees treated ore from the Daveytown property in a 5-stamp amalgamation mill and recovered gold bullion. The mine is opened by an inclined shaft and several hundred feet of drifts.

Black Rock district.—Two producers in the Black Rock district reported the production of ore from the Grubstake and Abe Lincoln claims. The Ownership mines were developed by the Mineral Development Co.

Gold Run district (Adelaide).—Siliceous silver ore was shipped from the Dolomite property and a small lot of gold ore from the Gold Coin property was milled in the 12-ton Gibson mill. Two operators recovered free gold from surface mining near Clear Creek, south of Golconda. Free gold has been found, but not in such quantity as to induce deep mining.

Iron Point district.—One small lot of silver ore was shipped from the Silver Coin property to a smelter, and siliceous ore carrying 15 to 43 ounces of silver to the ton was shipped to the copper smelters at Kennett, Calif., and Garfield, Utah. The Kernick Divide Mining Co. took under option six claims 4 miles south of Valmy. A shaft about 100 feet deep was sunk and in the course of development one car of siliceous ore valued at $10.45 a ton in gold was shipped.

National district.—During the last part of 1924 ore was produced from the property of the California National Gold Mining Co. on Buckskin Mountain, 3 miles southeast of National. Several lots of concentrate, with a little crude ore carrying gold chiefly, were shipped to the smelter. The 100-ton flotation mill, built in 1923, is equipped with a Marcy rod mill, Dorr classifier, 12 flotation cells, Oliver filter, and Dorr thickening tanks.

New Central district.—Lessees worked the Golden Eagle mine and shipped to the smelter ore containing lead, silver, and gold.

Winnemucca Mountain district.—Several operators reported an output of gold bullion from the treatment, by amalgamation, of ore from several unnamed mining claims in Ten Mile camp.

LANDER COUNTY

Battle Mountain district.—Eight operators of deep mines in the Battle Mountain district reported the production of 5,032 tons of ore, of which 3,090 tons were shipped to smelters and 1,900 tons were milled and yielded concentrate containing gold, silver, copper, and lead. A small amount of ore treated in an amalgamation mill yielded gold bullion. The largest producer was the Toulon Arsenic Co., which shipped arsenical ores to its roasting plant at Toulon. Part of the ore was treated in a wet concentration plant and the concentrate was roasted with the crude ore from the mine. Both the mine and mill were closed the 1st of June to await a better price for arsenic. The Buffalo Valley Mines, about 18 miles south of Valmy, yielded 43 tons of gold ore containing silver, which was shipped to the copper smelter at Kennett, Calif. The Copper Canyon property yielded more than 100 tons of copper ore of shipping grade; work at the mine ceased the 1st of May. Other producers were the

Golden Sceptre, Silver Bow, and Bentley properties. Many small lots of bullion deposited at the San Francisco Mint were credited to this district during 1924. Most of the gold was recovered by drift mining at placer claims in Copper Canyon. The total amount of placer bullion credited to the district contained $3,958 in gold and 26 ounces of silver.

Bullion district.—Oxidized lead ore containing silver was shipped from the Utah mine.

Cortez district.—Considerable ore was treated in the cyanidation and concentration plant of the Consolidated Cortez Silver Mines Co.[5] The product shipped consisted of silver bullion, concentrate, and cyanide precipitate. Because of a fire at the power plant of the company in May, the cyanide mill ran only part of the year. The mill treated 32,392 tons of ore and recovered 83.2 per cent of the silver and 90 per cent of the gold. The cost of treatment was $118,908, or $3.67 a ton. The operating statement covering the period between June 1, 1923, and February 28, 1925, shows that 55,939 tons of ore were treated which yielded $520,214.74 in gold, silver, and a little lead. Mining and development cost $256,926.20; milling, $253,450.63; general expense, $63,196.64; administrative and executive expense, $8,692.83, or a total of $582,266.30. The operating loss and the loss from running the boarding house amounted to $76,029.60.

Hilltop district.—Lead ore containing silver was shipped from the Ridge property, which is developed by open cuts and a tunnel 62 feet long. From the Blue Dick mine a lessee shipped three cars of silver ore averaging about 80 cents in gold and 17 ounces of silver to the ton, and carrying 90 per cent of silica, 2.5 per cent of iron, and 6 per cent of alumina.

Lewis district.—The chief producer in the Lewis district was the Betty O'Neal mine, where a flotation plant with a daily capacity of 250 tons was in operation in 1924. This plant handled 28,982 tons of ore which yielded 1,609 tons of concentrate.[6] The concentrate containing lead, silver, and a little gold was shipped to a smelter near Salt Lake. The concentrate contained 483,263 ounces of silver and a little gold, copper, and lead, valued in all at $339,665, which gave a net smelter return of $271,477 when freight and treatment charges were paid. The average value of the ore milled was $13.72 a ton; mill and smelter losses, $3.10; mining, $4.71; milling, $1.93; indirect cost of milling and marketing ore, $2.44; making a total cost of $12.18 a ton. The profit from ore milled was $1.535 a ton. Most of the ore was developed in the Estella vein, which is said to have produced very rich ore at the No. 4 level. The Nebraska vein was being developed at depth. The company owns in all 36 claims and 480 acres of land adjoining them. The claims held by the company extend its holdings to the old camp of Dean. An illustrated article[7] published in 1924 gives a general plan of the concentrator and reviews the history of the mine in some detail.

McCoy district.—A prospector who used a rocker obtained from a placer prospect bullion having a fineness of 0.756 in gold and 0.217 in silver.

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[5] Consolidated Cortez Silver Mines Co. annual statement for 1924.
[6] Betty O'Neal Mines Co. Ann. Rept. for 1924.
[7] Nevada's newest silver producer: Eng. and Min. Jour.-Press vol. 117, p. 449, Mar. 15, 1924.

Reese River district.—The Austin Manhattan Consolidated Silver Mines Co. did not operate its property, but shipped some siliceous silver ore while doing assessment work. The Lombardy property at Shoshone yielded lead ore which was hauled 2 miles to Ravenswood, on the Nevada Central Railroad, for shipment to the smelter.

LINCOLN COUNTY

Production in Lincoln County decreased considerably, though the number of producers increased from 10 to 13. The ore declined from 93,145 to 74,283 tons, gold from $87,215 to $65,826, silver from 655,776 to 420,943 fine ounces, copper from 348,466 to 144,650 pounds, lead from 6,842,459 to 4,851,928 pounds, and the total value from $1,342,563 to $954,826. Zinc increased from 2,756,118 to 3,074,843 pounds.

Comet district.—The Lyndon and Stella mines produced a small quantity of oxidized lead ore carrying silver.

Groom district.—From the Groom mine 194 tons of sulphide lead ore containing 3,326 ounces of silver and 232,250 pounds of lead were shipped to a smelter. The mine has a vertical shaft 114 feet deep, a tunnel 840 feet long, and 1,380 feet of drifts; 110 feet of this development was done in 1924.

Highland district.—The Pioche Union Mines Co., which mills Mendha ore, shipped lead concentrate containing silver and gold. A small quantity of lead ore was produced from the Hamburg property.

Jack Rabbit district.—From the Bristol Silver property 1,034 tons of ore containing 13,215 ounces of silver, 204,000 pounds of lead, and a little gold and copper were shipped to a smelter in Utah. The mine is opened by a 70° inclined shaft 1,100 feet deep. The ore mined, largely oxidized, contains, in addition to the metals mentioned, iron and manganese for which pay was received, but the zinc in the ore was penalized. An aerial tramway about 9,000 feet long extends from the mine to the shipping point at Jack Rabbit, on the narrow-gauge Pioche Pacific Railroad to Pioche. The tram terminal at Jack Rabbit was destroyed by fire in January but was in service again in May. The Bristol Silver Mines Co. owns the Black Metals mine, from which 2,773 tons of manganese ore, averaging about 25 per cent of manganese, were shipped to Ironton, Utah, for use in the iron blast furnaces of the Columbia Steel Corporation. All the ore mined came from development work. Lead ore carrying silver was produced from the Centennial claim of the Pioche Bristol property, which is opened by a vertical shaft 266 feet deep.

Pahranagat district.—The Rosie claim produced lead-copper ore of shipping grade, which carried 92 ounces of silver to the ton, and 14 per cent of lead, 9 per cent of copper, and 4.35 per cent of zinc. Lead ore was also shipped from the Silver Dollar claim. These properties are 52 miles from the railroad.

Pioche district.—Three producers in the Pioche district reported the output of 72,040 tons of ore and tailing, containing $63,651 in gold, 394,919 ounces of silver, 123,093 pounds of copper, 4,303,443 pounds of lead, and 3,074,843 pounds of zinc, valued in all at $888,512, or $12.33 a ton. The largest output of ore, 28,732 wet tons,

came from the Panaca claim of the Combined Metals lease; it carried gold, silver, lead, and zinc. A body of sulphide ore is opened by a vertical shaft 1,445 feet deep, and is worked by the lessee through the mines of the Amalgamated Pioche Mines & Smelter Corporation. The ore body is in a replacement in limestone and is said to average 92 feet in width and 27 feet in thickness. Considerable ore has been developed for several hundred feet down the dip and in places the ore almost completely replaces the thick bed of limestone. The ore mined averages 80 cents in gold and 8 ounces of silver to the ton, and 8 per cent of lead and 18 per cent of zinc. All the ore mined, except about 1,000 tons of smelting grade, was shipped to Bauer, Utah, for treatment in the mill of the Combined Metals Reduction Co. Part of the lead concentrate separated by flotation at this plant was treated by a hydrometallurgical process[8] by which lead chloride was produced. Lead concentrate and zinc concentrate were sold to reduction plants in Colorado, Utah, and Montana, but the reduction of lead chloride to metallic lead and silver did not reach the commercial stage. Iron-manganese ore containing a little silver and lead was shipped to smelters from the Virginia Louise property, as well as tailings from the old mill dumps of the Prince Consolidated mine.

Tem Piute district.—Oxidized lead ore was produced from the Bullwhip claim in the Timpahute Mountains. The ore contained 153 ounces of silver to the ton and 14.8 per cent of lead, 1.73 per cent of copper, and 2.8 per cent of zinc.

LYON COUNTY

In Lyon County the production of ore increased from 1,463 to 2,998 tons, and of silver from 5,037 to 9,626 fine ounces. Gold decreased from $50,325 to $22,583, and copper from 33,913 to 10,938 pounds; the total value declined from $59,440 to $30,465. Twelve producers reported production, the same number as in 1923.

Silver City district (Palmyra, Dayton, Como).—Most of the ore mined in the Silver City district was treated in cyanidation and amalgamation plants. Altogether 2,696 tons of ore and tailings were reported by eight producers. The gold recovered from this output amounted to $20,710 and the silver, which was largely contained in the bullion, to 5,697 ounces. The only exception was one lot of siliceous gold ore shipped from the Surprise property to the smelter at Kennett, Calif. Other producers of ore treated in the district were the Buckeye Comstock, New Bonanza Comstock, Canyon, and Oest properties.

Talapoosa district.—Siliceous ore containing silver and gold was shipped from the Talapoosa mine to the smelter at Kennett, Calif. One lot of similar ore went to Tonopah for treatment by cyanidation.

Yerington district.—Three producers in the Yerington district reported an output of ore amounting to 94 tons; this ore contained copper mainly but carried a little silver and gold. All the ore was of shipping grade and was sold to the copper smelter at Kennett, Calif. No ore was produced from the Mason Valley and Bluestone mines.[9] Rather than smelt the crude ore of these mines decision was made to treat it at the Bluestone mill. This project necessitated

[8] Snyder-Christensen process: Eng. and Min. Jour.-Press, vol. 119, Jan. 10, 1925, p. 60.
[9] Mason Valley Mines Co. Ann. Rept. for 1924.

erection of an electric tramway, which was completed from the Bluestone haulage level to the north end of the Mason Valley mine, and the tunnel driven 900 feet from the end of the tramway to a point where a shaft was started to the 570-foot level of the Mason Valley mine. It was expected that this work would be completed and mining resumed during the summer of 1925. The Bluestone mill has a daily capacity of about 800 tons of ore, which will be increased by additional machinery.

MINERAL COUNTY

The production of ore in Mineral County decreased from 139,929 to 5,010 tons, gold from $60,579 to $40,237, silver from 635,350 to 103,956 fine ounces, copper from 17,942 to 1,726 pounds, lead from 3,124,176 to 96,068 pounds, and the total value from $960,658 to $117,798. No zinc was produced in 1924, compared with 2,320,053 pounds in 1923.

Bell district (*Mina, Omco*).—The property of the Simon Silver-Lead Mines Co. was developed in 1924, but no ore was produced. More zinc has been produced from this property than any other in the county.

Buena Vista district.—Siliceous silver ore from the R. & S. mine was shipped to the smelter at Kennett, Calif. This property is 15 miles northeast of Benton, Calif., which is the supply point for the mine.

Columbus district.—Renewed activity at the property of the New Candelaria Mines Co., operating the Northern Bell property, resulted in the production of considerable silver bullion containing gold.

Garfield district.—Both sulphide and oxidized ore were shipped from the Mabel group,[10] which was operated continuously in 1924. The shaft was continued to a depth of 595 feet. The ore, of which 401 tons were shipped to the West End cyanide mill at Tonopah, contained 589.64 ounces of gold, 42,780 ounces of silver, and 77,132 pounds of lead, valued in all at $46,814.82, or $116.75 a ton. The expenditures were: For mining, $31,351; improvements, royalty, and boarding-house loss, $17,587.65. The net smelter return, minus hauling and freight, was $31,343.72.

Hawthorne district.—Four producers in the Hawthorne district reported the output of 46 tons of ore and a little gold bullion. Siliceous ore for converter lining was shipped to the copper smelter at Kennett, Calif., from the 1917 property and the Western Girl claim, and gold bullion was produced from ore of the Gold Bug and Sunset properties.

Pinegrove district.—A small lot of gold was produced from the Wheeler and Red Rock claims.

Rand district.—Four producers in the Rand district reported the shipment of 370 tons of ore, containing $15,696 in gold and 33,678 ounces of silver, valued together at $38,260, or $103.41 a ton. The richest ore came from the east end of the 250-foot level of the Rand mine. The lower-grade shipments were valued at $41.49 a ton and the higher-grade ore at $213.52 a ton in gold and silver. The Gold

[10] West End Consolidated Mining Co. Eighteenth Ann. Rept., for 1924.

Pen mine shipped two small lots of gold ore, one lot averaging 140 ounces of gold and 466 ounces of silver to the ton and the other lot 7.24 ounces of gold and 29.9 ounces of silver to the ton. Other producers were the Lone Star and Antelope properties.

Regent district (*Rawhide*).—Ten producers in the Regent district reported the output of 221 tons of ore; 80 tons were of shipping grade and 141 tons were treated in milling plants and gold bullion recovered. The total output of the district contained $3,854 in gold and 4,520 ounces of silver, and one lot contained a little copper, valued in all at $6,888. Production of ore was recorded chiefly from the Blue Bell, Mascot, Morning Star, Patsy V., and Rawhide mines. A small quantity of placer gold from surface mining was reported by a dealer in bullion.

Ryan Canyon district.—One lot of lead ore containing 48 per cent of lead and a little silver and gold was produced from the Bismark prospect, about 6 miles from Thorne.

Santa Fe district.—Very little work was done in the Santa Fe district in 1924, and only two small lots of ore from prospects were reported by producers.

Silver Star district (*Marietta, Black Mountain*).—The output of 345 tons of ore by seven producers in the Silver Star district contained $4,068 in gold, 503 ounces of silver, a little copper, and 5,537 pounds of lead, valued in all at $4,852. Most of the ore produced came from the Douglass property and was treated in the 20-ton amalgamation ball mill, which ran six weeks during the year. Development work proceeded on the 700-foot drainage and transportation tunnel, which was nearing completion. It was expected that the mill would be remodeled and its capacity enlarged. Approximately 25,000 tons of $8 gold ore have been developed in the property, which is opened by 10,000 feet of drifts and 4,000 feet of crosscuts. Milling ore was reported from the Gold Scratch and Hontoon claims, at Excelsior, and lead ore was shipped to a smelter near Salt Lake from the Silver Gulch property, 3 miles north of Marietta.

Walker Lake district.—A lessee working on the Contact group produced one lot of sulphide lead ore.

NYE COUNTY

Producers in Nye County decreased from 81 to 69, ore from 415,739 to 302,894 tons, gold from $1,642,719 to $1,470,855, silver from 5,232,433 to 5,029,825 fine ounces, and the total value from $5,934,706 to $4,847,716. Copper increased from 572 to 1,694 pounds and lead from 18,681 to 83,201 pounds. The placer output of gold and silver, included above, decreased from $37,950 to $19,083 in gold and from 1,016 to 461 fine ounces of silver, and the value of both metals from $38,783 to $19,392.

Bannack district.—The Sylvanite prospect 17 miles northeast of Tonopah was developed, and oxidized gold-silver-manganese ore was shipped to a cyanidation plant at Tonopah.

Bellehellen district.—Rich gold and silver ore was mined from the Clifford property and treated in cyanidation mills at Tonopah. Two small lots of gold ore from prospects in the Bellehellen district were sold to a smelter.

Bruner section (Phonolite).—Silver ore from the Silver Shoot claim was shipped to the smelter, and rich ore from the Paymaster group was tested in an amalgamation mill on the property of the Kansas City-Nevada Consolidated Mines Co.

Bullfrog district.—Silver ore containing gold was shipped from the Original Bullfrog property, and lessees operating the Montgomery Shoshone mine shipped ore to a mill at Tonopah.

Hannapah district.—Free milling gold ore produced from a prospect was treated in a hand mortar, and small lots of ore were shipped from the Silver Leaf claim to Tonopah.

Johnnie district.—Gold bullion was recovered from ore mined from the Crown Point and Johnnie properties. The output of placer gold from dry washing did not come up to the usual output of past years.

Mammoth district.—The Illinois and Quartz Mountain properties produced small lots of lead-silver ore of shipping grade.

Manhattan district.—Eleven producers of ore in the Manhattan district reported the output of 8,967 tons; all of it was milled but 609 tons, which was shipped to an arsenic plant at Martinez, Calif., making weed killer. The roasted residue from this arsenic plant was sold to a smelter; therefore much of the gold was saved and is included in the total output of the district. Most of the milling ore was treated in the White Caps mill, which has a Wedge roaster and cyanide plant. The gold ore from the Jumbo property was treated by amalgamation in a small-size Herman ball mill. Gold bullion was also recovered from ores treated by amalgamation from the Jumping Jack, Stray Dog, Big Four, Manhattan Consolidated, Midas, April Fool, and Manhattan Union properties. Placer operators working property by drift mining reported a production of $13,518 in gold and 305 ounces of silver. Most of this bullion had a fineness of 0.615 to 0.705 in gold.

At the White Caps mine the inclined shaft was extended on a 45° slope 481 feet below the 800-foot level. Some ore containing about $30 in gold and silver was opened at 350 feet below the 800-foot level.

Millett district.—The Mammoth Contact property, in Last Chance Canyon, produced lead ore.

Reveille district (Arrowhead).—Oxidized silver-lead ore was shipped to Tonopah from the Reveille mine by lessees. Oxidized lead ore was also shipped to a lead smelter near Salt Lake City.

Round Mountain district.—Ore of milling grade amounting to 11,092 tons was treated in amalgamation plants and produced bullion containing 9,057.59 ounces of gold and 5,312 ounces of silver. One small lot of silver ore was shipped to a smelter. All the ore produced from the properties of the Fairview and Round Mountain Mining companies was treated in their own mills, which operated continuously during 1924. Operators of three surface placers reported a production of $4,112 in gold and 115 ounces of silver. Most of this output came from property owned by the Round Mountain Mining Co., whose annual printed report, which formerly gave details, was not issued for 1924.

San Antone district (Royston).—Siliceous silver ore and lead ore were shipped from the Hudson property to a smelter and to the mills at Tonopah. The mine is opened by a 38° inclined shaft 500 feet deep.

Tonopah district.—Thirteen producers in the Tonopah district, including those in Esmeralda County, reported the output of 285,707 tons of ore. All the ore was highly siliceous, containing silver chiefly, and most of it was of milling grade. Dividends paid in 1924 by two companies amounted to $428,543. An increase was recorded in gold, but the tons of ore, quantity of silver, and total value decreased in 1924, as shown in the following table:

Mine production of gold and silver in the Tonopah district, Esmeralda and Nye Counties, Nev., in 1924

	Producers	Ore	Gold	Silver	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1924	13	285,707	$1,161,993	5,032,043			$4,533,462
Increase or decrease from 1923	−3	−86,239	+54,664	−144,263			−818,438
Total, 1904-1924		7,439,490	32,536,985	148,549,593	12,113	214,523	132,750,809

The Belmont mine[11] was the third largest producer of silver in Nevada in 1924. The total ore produced amounted to 36,568 dry tons, which was of slightly higher grade but smaller than the output of 1923 by 8,555 dry tons. All the ore was milled at the plant of the Tonopah Mining Co. at Millers, and contained 10,388.72 ounces of gold and 838,051 ounces of silver, valued together at $777,333.80, and averaged 0.284 ounce of gold and 22.92 ounces of silver, a total value of $21.26 to the ton. Freight, milling, and metal losses aggregated $6.45 a ton, leaving a net value of $14.81 a ton, or a total of $541,534.96 for the output. The total operating cost was $9.62 a ton, or $351,849.14 for the entire output, leaving a net profit of $5.19 a ton of ore mined, or a total profit of $189,685. No dividends were paid in 1924.

From the property of the Tonopah Mining Co.[12] were mined 24,067 tons of ore, which contained 6,176 ounces of gold and 613,912 ounces of silver. Of this output, 2,401 tons of refractory manganese-silver ore, which could not be advantageously treated by the cyanide process, were shipped to the smelter at Kennett, Calif. A direct operating profit of $225,112.82, or $10.39 a ton, was derived from treating 21,666 tons of company ore at the Millers plant, and $19,106 from the ore shipped to the smelter.

The yield from the Tonopah Extension property[13] was 171,046 tons of ore, 26,129 tons more than in 1923. All the ore was treated by cyanidation and contained 2,927,721 ounces of silver and 31,524.63 ounces of gold. The total value of the ore was $2,641,447. The tailing contained $1.017 a ton, or a total loss of $173,998. The recovery was 2,717,932 ounces of silver and 30,004.75 ounces of gold, valued together at $2,467,449. The cost of mining, including all development, was $5.89 a ton, milling $3.34, and marketing, including refining, express, and freight, $0.288—a total cost of $9.51. With the metal loss in tailing of $1.02 and the cost of depreciation, etc., amounting

[11] Tonopah Belmont Development Co. Ann. Rept. for 1924.
[12] Tonopah Mining Co. Ann. Rept. for 1924.
[13] Tonopah Extension Mining Co. Twentieth Ann. Rept., for year ended Mar. 31, 1925.

to $0.45 a ton, the total cost was $10.98 a ton. The net amount realized per ton of ore was $4.50. Dividend distributions during the company's fiscal year amounted to $278,543, making a total of $3,853,335 since July 1, 1905. Underground mining was done from the No. 1, No. 2, McKane, and Victor shafts. The Cash Boy shaft was sunk 415 feet below the 2,000-foot level and new levels established at 2,125, 2,250, and 2,375 feet. The following paragraph is taken from the company's report:

> The poor showing on the 2,125, 2,250, and 2,375 foot levels has left the available ore supply very low. The future ore supply is therefore dependent upon developing new bodies of ore. The existence of several of these ore bodies in the property, and west of the present producing area, is known. Their full development, however, has not been possible in the past. The large flow of water that will be developed in doing this work makes it necessary that a continuous supply of electric energy be always available.

The West End property[14] produced 43,745 tons of milling ore, containing 8,564.14 ounces of gold and 783,953 ounces of silver, valued together at $701,646, or $16.04 a ton. All this ore came from the West End and Ohio veins. The Fraction and other subsidiary veins produced 3,377 tons of ore averaging $12.90 in gold and silver to the ton. These ores were treated in the company's cyanidation plant, which also treated custom ore. Several lots of waste dump ore averaging $5.27 a ton in gold and silver were shipped to the smelter at Kennett, Calif. The average mining cost for the year was $5.17 a ton; milling the ore cost $3.58 a ton; mine development cost was 64 cents a ton; and tailing losses amounted to $1.19 a ton, which, with the cost of marketing bullion and transporting ore, made a total of $11.15 a ton, and left a total operating profit of $4.89 a ton.

On July 12 the property of the Tonopah Midway Consolidated Mining Co. was purchased by the Tonopah Divide Mining Co. All the ore produced during 1924 from the Midway group amounted to 878 tons, the larger part of which was milled in the West End cyanidation plant; several lots of low-grade siliceous ore were shipped to the smelter at Kennett, Calif.

The West End mill treated 381 tons of ore from the Halifax Tonopah property.[14] The gross value of the ore was $10,331. The loss in milling was $770, hauling and milling charges were $2,123, lessees were paid $4,417, and operating costs were $39,296, showing an operating loss of $36,276.

Ore shipped from the Rescue Eula mine to the West End mill amounted to 777 tons and contained 139 ounces of gold and 12,812 ounces of silver, valued together at $9,966. Other producers of silver ore were the Montana Tonopah, Monarch Pittsburg, and Jim Butler properties.

Union district.—Amalgamation in a muller recovered gold bullion from a small lot of ore from the Jessie prospect.

Willow Creek district.—One small lot of lead ore hauled from Nyala to Tonopah and a little ore treated in an amalgamation plant from the Auriferous prospect comprised the total production of the Willow Creek district.

[14] West End Consolidated Mining Co. Eighteenth Ann. Rept., for 1924.

ORMSBY COUNTY

Carson River district.—A mill on the Carson River that uses amalgamation and concentration treated old tailing that originated from the Comstock lode. Gold and silver bullion was shipped from these operations.

Delaware district.—The Comstock Triumph mine 4 miles southeast of Carson City produced 12 tons of lead-silver ore, which contained 45 ounces of silver to the ton and 27 per cent of lead.

PERSHING COUNTY

Antelope district.—The output of 734 tons mined by three producers in the Antelope district was largely arsenical ore shipped to the arsenic plant at Martinez, Calif. Lessees of the Arsenic King claim produced oxidized ore containing an average of about 20 per cent of arsenic and 6 ounces of silver to the ton. From the Last Chance claim and the property of the Majuba Fresno Silver Mines Co. oxidized lead ore containing silver and some zinc unpaid for was shipped to a smelter near Salt Lake. The ore from these properties was hauled 20 miles to the Southern Pacific Railroad and loaded at Humboldt. From the Antelope mine a lessee shipped lead ore containing copper and silver, which was loaded at Jungo, on the Western Pacific Railroad, for shipment to the smelter.

Arabia district (Oreana).—From the Jasper group of claims a lessee shipped lead ore containing silver.

Fitting district.—Placer property in Spring Valley produced a small quantity of gold having a fineness of 0.698.

Jersey Valley district.—A lessee at the Jersey Valley mine, 43 miles southwest of Battle Mountain, shipped ore from an old dump and slag from former smelter operations. Both products contained gold.

Kennedy district.—From the Fourth of July claim a small quantity of silver ore carrying gold was shipped to the smelter at Kennett, Calif.

Loring district (Willard).—Gold bullion was shipped from the treatment of May Day ore in a hand mortar.

Mandalay district.—A trial shipment of very low-grade silver ore was made from the Resurrection group of claims.

Rochester district.—Eight mine operators in the Rochester district reported the output of 28,779 tons of ore and mill-pond sweepings. The yield from this output, including a little gold recovered from surface placer mining, was $113,882 in gold and 329,819 ounces of silver, valued together at $334,861. The ore and sweepings averaged $11.57 a ton in gold and silver. The largest producer was the property of the Rochester Silver Corporation, although its mine and mill were operated by lessees for eight months only at reduced capacity on account of the shortage of power. Ore from the Lincoln mine produced gold bullion when treated in the 2-stamp amalgamation mill owned by the Great Western Mines Co. Silver ore from the Limerick Consolidated, Rochester Lincoln Hill, and several other claims was treated in the cyanidation plant of the Rochester Silver Mines Corporation. Six placer mines reported $1,976 in gold and

35 ounces of silver. Most of the gold came from drift mining and sluicing in Limerick Canyon. The United States Geological Survey recently issued a geologic report[15] of the history, production, and geology of the ore deposits in the Rochester district.

Rye Patch district.—In the course of development work, milling ore, from which gold and silver bullion was recovered, and a little gold and silver ore was shipped from the Modoc prospect.

Seven Troughs district.—Lessees working the property of the Seven Troughs Reorganized Mines produced milling ore from which gold and silver bullion and some concentrate were recovered. The mine is developed to a depth of 1,800 feet by vertical and inclined shafts. In 1924 the upper workings were leased and the ore mined came from the zone between the surface and the 400-foot level. The lessees treated the ore in a 10-stamp mill that had a capacity of 50 tons and was equipped with amalgamators and two concentrators. A drainage tunnel was started in 1924 to drain the lower levels.

Sierra district (Dun Glen, Central, Sunshine).—Seven producers in the Sierra district reported 198 tons of gold and silver ore, which was of shipping grade with the exception of 2 tons which yielded a little gold bullion. The chief shipments of silver ore were from the property of the Sierra Platada Consolidated Mines Co. A recent consolidation of several groups of claims included the Silver Queen, Essex, Empire, and Helmar Thomas groups, which are 10 miles northeast of Mill City in the Pahute or East Range. Development work on the claims consists of about 5,000 feet of tunnels and drifts. Silver ore was produced at the Gem Five and Black Rock properties 18 miles south of Winnemucca. A lessee working the Black Hole & Mayflower property shipped a few tons of gold-silver ore to the copper smelter at Kennett, Calif.

Unionville district (Buena Vista).—Six producers in the Unionville district reported the production of 3,714 tons of ore and tailings containing $4,946 in gold, 10,559 ounces of silver, 10,551 pounds of lead, and a little copper, valued in all at $12,946, or $3.49 a ton. The chief producer was the Treasury property, operated by the Unionville Mining Co. Silver ore and oxidized lead ore were shipped from the Manoa property, worked by the Lead Co. of Nevada. The owners of the property believe to ship ore at a profit is almost impossible, and a reduction plant on the property is necessary.

STOREY COUNTY

Comstock district.—All the ore produced and tailings treated in Storey County came from the Comstock district and amounted to 547,428 tons in 1924, compared with 584,237 tons in 1923. Gold increased from $956,818 to $1,108,743, silver from 1,357,559 to 1,616,692 fine ounces, and the total value from $2,070,150 to $2,192,021. Copper decreased from 912 to 720 pounds. The number of producers increased from 21 to 24. The total included some old tailings shipped to smelters and tailings that yielded gold and silver bullion

[15] Knopf, Adolph, Geology and ore deposits of the Rochester district, Nev.: U. S. Geol. Survey Bull. 762, 1924, 78 pp.

and concentrate containing a little copper. Altogether 541,985 tons of ore and 1,816 tons of tailings were milled, producing 51,811.46 ounces of gold and 1,587,688 ounces of silver. The ore of smelting grade amounted to 3,226 tons and contained 1,464.73 ounces of gold and 25,505 ounces of silver; and 401 tons of tailings, also sold to the smelter, contained 359.25 ounces of gold and 3,499 ounces of silver. Nearly all the crude ore and tailings shipped were sold to the smelter at Kennett, Calif., for converter lining. This class of ore was mined from the Middle Mines, Chollar lease, Comstock Phoenix, Comstock Tunnel, Justice, and Ophir properties. Prospectors in the district who had leased old mine and mill dumps shipped directly to the smelter or produced bullion. Gold and silver bullion was recovered from ore produced from the Consolidated Virginia, Succor, Silver Hill, Lady Bryan, Overland, Phoenix, and Comstock Home mines. The attempt to concentrate the tailing of the Butters dump in Sixmile Canyon was continued. On October 1 the Comstock Merger Mines Co. took over the holdings of the United Comstock Mines Co., consisting of a modern cyanide plant and a long haulageway, for less than $1,000,000. The "Merger" continued the operations of the United Comstock mill, which was treating an average of 1,400 tons of ore a day at the time of the sale, and with considerable ore to its credit from the "Middle Group" of mines made the output of ore reach an important figure. The Comstock Merger Mines Co. is owned jointly by the Gold Fields American Development Co., which is the American subsidiary of the Consolidated Gold Fields of South Africa, and the National Mining Corporation (Ltd.). The new owners of the United Comstock mines organized a subsidiary, the Comstock Milling Co. The main transportation tunnel is to be extended north to open the original holdings. Nearly 2,000,000 tons of profitable ore are reported to have been developed in the old Savage, Gould & Curry, Chollar-Potosi, and Hale & Norcross properties.

WASHOE COUNTY

Leadville district.—The Leadville Mines Co. kept its 60-ton flotation plant running throughout the year. The equipment consists of a Marcy ball mill, K. and K. flotation cells, and an Oliver filter. The flotation concentrate is dried to contain 5 per cent moisture, sacked for shipment, and hauled 40 miles southwest to Gerlach, the loading station on the Western Pacific Railroad. The mine is developed by an inclined shaft 750 feet deep and a tunnel 1,800 feet long. Old tailing from the Glen property yielded one lot of concentrates containing silver and lead principally. The ratio of concentration was 25 to 1.

Peavine district.—Two producers in the Peavine district, the Reorganized Silver King Divide Mining Co. and the Gold Bond property, shipped copper ore and silver ore.

Washoe district.—The Rocky Hill property at Steamboat produced 66 tons of arsenical ore, which was shipped to the National Chemical Co. at Pittsburg, Calif. The ore was roasted and the white arsenic produced was used in the manufacture of calcium arsenate.

Wedekind district.—The Wedekind Mines Co. produced ore of shipping grade that contained silver, a little copper, and lead from a property developed by a shaft 165 feet deep.

West Comstock district.—At the Bargo mine a two-stamp amalgamation mill was in operation and gold bullion was shipped to the mint.

White Horse district.—Small producers of free-milling gold ore in the White Horse district reported the treatment of 154 tons, which contained $5,764 in gold and 114 ounces of silver. The Springfield-Nevada property yielded the main part of the output, and the Ruth R., Renegade, Caroline, Crown Point, Hutchison, and White Dog properties yielded smaller quantities of ore.

WHITE PINE COUNTY

In 1924 all the metals except lead and zinc showed increases in White Pine County. The ore increased from 2,844,704 to 3,516,230 tons, gold from $614,311 to $670,541, silver from 141,363 to 149,530 fine ounces, and copper from 65,938,720 to 73,290,006 pounds. Lead decreased from 2,420,800 to 2,286,522 pounds, zinc from 334,952 to 19,025 pounds, and the total value from $10,615,454 to $10,555,875. The number of producers (27) was the same as in 1923.

Cherry Creek (Egan Canyon) district.—Three producers in the Cherry Creek district who operated the Exchequer, Star, and Nevada Northern properties reported 57 tons of ore, containing silver mainly with some gold, copper, and lead.

Duck Creek district.—Three producers in the Duck Creek district shipped 139 tons of ore which contained 208 ounces of silver, 114,818 pounds of lead, and a little gold and copper. Most of the ore came from the Ely Amalgamated copper property; smaller lots came from the Gibralter mine and from a prospect.

Eagle district (Regan).—Lessees of the Dandy mine near Tippett produced several lots of lead-silver ore, which were hauled to Gold Hill, Utah, on the Western Pacific Railroad, and shipped to smelters.

Granite district (Steptoe).—The larger part of 138 tons of lead ore came from the Cuba mine. The ore was shipped by lessees to a lead smelter near Salt Lake.

Osceola district.—Gold bullion was reported recovered from ore mined in the Crescent and other properties in the Osceola district. Placer gold was reported recovered from gravels in the district.

Robinson district (Ely).—The output of all metals produced in the Robinson district except zinc increased in 1924—gold from $610,892 to $668,376, silver from 82,675 to 113,967 fine ounces, copper from 65,928,279 to 73,279,064 pounds, and lead from 120,094 to 163,516 pounds. The total value decreased from $10,401,327 to $10,358,608 and the zinc production from 334,952 to 19,025 pounds. The total output of the district from 1904 to 1924 has been as follows: Ore, 44,956,977 tons; gold, $7,585,312; silver, 1,312,365 fine ounces; copper, 1,005,683,776 pounds; lead, 3,296,416 pounds; zinc, 5,801,295 pounds; total value, $188,207,485.

Mine production of gold, silver, copper, lead, and zinc in the Robinson district, White Pine County, Nev., in 1924

	Producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	4	3,505,362	$668,376	113,967	73,279,064	163,516	19,025	$10,358,608
Increase or decrease from 1923	−3	+671,688	+57,484	+31,292	+7,350,785	+43,422	−315,927	−42,719
Total, 1904–1924		44,956,977	7,585,312	1,312,365	1,005,683,776	3,296,416	5,801,295	188,207,485

At the reconstructed concentrator of the Nevada Consolidated[16] minor changes in the flow sheet and improvements in metallurgy gave encouraging results in the fourth quarter of the year. A recovery of 90.85 per cent was achieved with milling ore lower than the average grade. During 1924 the superstructure necessary to house 26 fine-grinding ball mills, each of 500 tons daily capacity, was completed. Twenty-two ball mills and other necessary equipment, including tables, flotation cells, etc., were in operation, giving a nominal capacity of 11,500 tons. Construction of the extension of the coarse-crushing plant and of the smelter crushing plant was continued. The ore milled amounted to 3,418,900 dry tons; it averaged 1.198 per cent copper, of which 87.09 per cent was recovered. The concentrate, averaging 9.61 per cent copper, and crude ore from the Ruth sedimentary deposits, averaging about 7 per cent, were treated in the company's smelter at McGill. The bullion produced contained 70,237,050 pounds of fine copper, 32,151.60 ounces of gold, and 104,994 ounces of silver, valued in all at $9,920,822. The total ore in reserve, calculated to the end of 1924, is 57,225,060 tons and averages 1.64 per cent copper. This amount includes 47,217,693 tons, averaging 1.447 per cent copper, to be steam-shoveled from the "pits"; 9,751,516 tons, averaging 2.426 per cent, from the Ruth porphyry deposit; and 255,851 tons, averaging 7.509 per cent, from the Ruth sedimentary deposit. Of the ore mined in 1924, 78.82 per cent was from the "pits" and 21.18 per cent from the Ruth underground mine. The company's report gives the following comparison of mill assays and drill-hole sampling:

> In the 1923 annual report mention was made of a check of the Copper Flat steam-shovel ore sections mined to December 31, 1923, compared with the mill assay and tonnage returns of these same ore sections mined. Of the 30,701,796 tons of ore mined, averaging 1.55 per cent of copper, the actual tonnage was 114.48 per cent of development expectancy, actual grade was 99.61 per cent of expectancy, and actual copper 114.04 per cent of expectancy. This is a highly satisfactory result and indicates clearly, first, that drill-hole sampling is as accurate as any other in developing large disseminated ore bodies; and second, that the copper grade holds fairly uniform between holes 200 feet apart, provided there is no change in the nature of the porphyry mass as determined by the surface capping.

Costs of steam-shovel mining of concentrating ores, exclusive of depreciation and Federal, State, and local taxes, but including all other overhead expense, were 21.42 cents a ton of ore and 47.67 cents a cubic yard of capping. These costs do not include 40 cents a ton

[16] Nevada Consolidated Copper Co. Eighteenth Ann. Rept., for 1924.

of ore mined, which is charged regularly to cover stripping expense. The cost of underground mining in the Ruth mine averaged 96.9 cents a ton. Milling of the ore cost 59.7 cents a ton. With depreciation of plants and equipment, all taxes, and general and other overhead expenses included, the total operating cost was 10.70 cents a pound of copper produced, after credits were applied for gold and silver and miscellaneous earnings. This figure compares with a cost of 10.92 cents a pound similarly calculated for 1923.

The Consolidated Coppermines Corporation[17] mined ore from the Richard mine amounting to 24,681 tons, containing 2,618,061 pounds of copper, 76.94 ounces of gold, and 603.77 ounces of silver. From leaching ore in place on the Brooks mine 212,654 pounds of copper were produced. Leaching operations started late in 1924. The average circulation of leach solution, carrying 7.14 pounds of copper to 1,000 gallons, was approximately 230 gallons a minute. Recovery amounted to 86.73 per cent. All the ore and copper precipitate was treated at the Nevada Consolidated smelter at McGill. The company's report continues with the following notes:

> Fourteen hundred and eighty-seven feet of diamond drilling was completed from underground stations in the Richard mine, the holes being confined to the second shear zone. Although some ore was encountered, the results were disappointing, but the porous and leached conditions of this zone between the sixth and eighth levels warrant exploration at greater depth. The third fracture zone remains as virgin territory.
>
> Of the 11 churn-drill holes located on the April Fool, Watson, April Fool Fraction, Miranda, and Beehive claims in the area adjoining the western side of the Nevada Consolidated Copper Co.'s Liberty Pit, but 2 have failed to find ore in commercial quantities. A total estimated tonnage of 4,650,000 tons of 1.40 per cent ore has been developed by the drill holes in this area, and as the drilling campaign is still in progress, a greater reserve is confidently expected.

Ward district (*Taylor*).—The Ward Leasing Co., operating the Ward mine, shipped about 10,000 tons of lead ore.

White Pine district (*Hamilton*).—Considerable development work was reported and as a result of that work there was shipped to smelters 303 tons of ore containing $301 in gold, 4,864 ounces of silver, 6,123 pounds of copper, and 177,492 pounds of lead, valued in all at $18,561, or $61.26 a ton. The Great Valley and McEllin mines were the principal producers of lead ore. Other producers of small lots of ore were the Dover, Midnight, and Rocco Homestake properties. The Tonopah Mining Co. did considerable crosscutting and drifting on veins in the Treasure Hill section, and though some ore was found, available reports do not indicate that important ore bodies were opened.

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[17] Consolidated Coppermines Corporation Ann. Rept., for 1924.

RARE METALS

By Frank L. Hess[1]

COBALT

No cobalt minerals are known to have been mined in the United States during 1924, and none were produced in 1923. During the year the Mar-John Mining Co. was prospecting a deposit of cobaltiferous arsenopyrite on a claim known as the "Hauselt Patent," in the NW. ¼ of the NW. ¼ sec. 22, T. 4 N., R. 14 E., 2 miles southeast of Sheepranch, Calaveras County, Calif. When the prospect was visited, July 21, 1924, an inclined shaft 65 feet deep had been sunk along a faulted zone that followed closely the bedding planes of a gray quartz-mica schist, which dips about 60° N. 15° W. The faulted zone is as much as 2 feet wide, is considerably iron stained, and contains crushed masses of fine-grained arsenopyrite that on being taken to the surface is soon more or less coated with beautiful rose-pink erythrite (hydrous cobalt arsenate). A white material accompanying the arsenopyrite in the fault is apparently a rhyolite dike which has been crushed and changed to a clayey mass.

The arsenopyrite is in lenses and in fluted masses almost columnar in form, from a few inches to 2 feet thick. More or less had been found from the surface to the bottom of the incline.

No pyrite was seen, but it seems to have been present in small quantity and has weathered out. No original cobalt minerals as such have been recognized, but whether the cobalt is present in the arsenopyrite as danaite (cobalt-bearing arsenopyrite) or as other minerals can not be determined without further work. The company reports that it has had returns of 4 to 20 per cent cobalt in the ore.

Some good specimens of erythrite (hydrous cobalt arsenate) partly coated with heterogenite (cobalt oxide) and containing kernels of cobaltite (cobalt sulpharsenide) or smaltite (cobalt diarsenide) were received from W. H. Fowler, White River, Ariz. The deposit from which the specimens were obtained is in the Fort Apache Reservation, 50 miles north of Rice. They seem to have come from a vein less than 2 inches wide.

The world's needs for cobalt were largely supplied in 1924 by the production of cobalt from Cobalt, Ontario; Mount Cobalt, Queensland, Australia; and the by-product metal obtained by the Mond Nickel Co. in extracting the nickel from ore mined near Sudbury, Ontario.

[1] The statistics of imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

During the year the Union Minière du Haut-Katanga continued its study of the cobaltiferous copper ores found near Elizabethville, Belgian Congo, and—

three electric furnaces [capacity not given] were constructed at Panda and their use was begun in March and May, 1924. The furnaces produce a copper-cobalt-iron alloy that is shipped to Belgium and treated by a process developed and used by the Société Générale Métallurgique [a subsidiary] at Hoboken, Belgium.

USE OF COBALT IN ALLOYS

At present the chief use for cobalt is possibly in making stellite, a group of alloys, invented by Elwood Haynes, that contain cobalt and one or more of the following metals: Chromium, tungsten, molybdenum, iron, and nickel.

The first patent issued for these alloys [3] covered an alloy "composed of chromium and cobalt in the proportions of more than 10 per cent and less than 60 per cent of chromium, the remainder of the alloy being cobalt," but the patentee also stated, "I desire it to be understood, however, that I may combine small quantities of other substances with the alloy described such as will not objectionably effect [*sic*] the nature of the binary alloy for the purposes stated"; moreover, he included a metal of the chromium group in place of chromium. Mr. Haynes described uses of the alloy as follows:

This invention relates to a novel metal alloy designed for use in the manufacture of articles requiring a high and durable luster and possessing a degree of hardness adapting it to be substituted for mild-tempered steel in the manufacture of edge tools, as table and pocket cutlery, physicians' and dentists' instruments, or standards of weight, measures, etc., etc.

Among the objects of my invention is to produce a commercially practical metal alloy having the properties above set forth and which is capable of being forged, hammered, or otherwise worked into various forms of instruments and articles and which is highly adapted, among other uses, as a substitute for steel and other metals which have been heretofore plated in order to provide a suitable luster and resist the oxidizing and corrosive action of the atmosphere and fumes commonly occurring in the atmosphere; and also to provide an alloy that is capable of being substituted in many cases for the rare and highly expensive metals comprising the so-called polyxene group, including platinum, rhodium, iridium, palladium, and osmium.

By a later patent [4] Haynes included ternary alloys of chromium, cobalt, and another metal of the chromium group, preferably tungsten or molybdenum, and quaternary alloys of all four metals. The patent also covered the use of the other member of the chromium group, uranium.

A preferable composition for a ternary compound for wood-cutting and other edged tools was as follows: Chromium, 25 per cent; tungsten, 5 per cent; and cobalt, 70 per cent. This alloy was described as readily forgeable. The corresponding molybdenum alloy was claimed to possess similar properties.

In another patent, issued on the same date, Haynes covered quaternary alloys of cobalt, chromium, tungsten, and molybdenum with which "small quantities of other metals or nonmetals" might be combined.[5]

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[2] Union Minière du Haut-Katanga, Annual report for 1923. July 14, 1924, p. 10.
[3] Haynes, Elwood, Metal alloy. United States Patent 873745, Dec. 17, 1907.
[4] Haynes, Elwood, Alloy for tools. United States Patent 1057423, Apr. 1, 1913.
[5] Haynes, Elwood, Alloy for cutting tools. United States Patent 1057828, Apr. 1, 1913.

In a later British patent [6] Haynes covered cobalt-chromium alloys that also carry enough iron or nickel to soften the metal. The alloys preferably contain about 20 per cent of chromium, 75 to 5 per cent of cobalt, and 5 to 7.5 per cent of iron and a low carbon content, but the chromium content may be increased to 80 per cent and a small percentage of other metals, such as molybdenum, may be introduced.

In 1923 Frederick T. McCurdy [7] patented the addition of tantalum to stellite, claiming that it makes a denser, finer-grained alloy, and that the cutting speed of tools is increased one-third.

The less hard stellites are used for cutlery of various types, including scalpels and other surgical instruments. These may be sterilized either in a flame or in any of the ordinary antiseptics without injury either to the edge or the polish. Stellite table cutlery has been used for years without tarnishing or loss of the original polish.

In the making of high-speed steels, a certain quantity of cobalt is used which varies with the maker. Such alloys are said to be among the very highest type high-speed steels. Perhaps the five shown in the following table may be taken as representative.

Composition of cobalt high-speed steels

	Furness [a]		Furness and Patch [b]		Iridium	K. S. [c]	Parker and De Long [d]
	Preferred analysis	Limiting percentages	Preferred analysis	Limiting percentages			Approximate composition
Carbon (C)	0.70	0.5– 0.9	0.65	0.55– 0.75	0.60	0.54	0.35
Chromium (Cr)	3.5	2.0– 6.0	4.00	2.0 – 6.0	3.55	2.44	3.50
Cobalt (Co)	4.5	3.0– 7.0	15.00	5.0 –20.0	4.25	39.30	30.00
Tungsten (W)	13.5	12.0–20.0	13.50	9.0 –15.0	16.00	6.36	12.00
Uranium (U)	.7	.1– 2.0	None.	None	.80	[f].50	None.
Vanadium (V)	1.5	.5– 2.0	1.5	1.0 – 2.0	.67		2.00
Iron (Fe)	[g]	[g]	[g]	[g]	74.00	[g]	52.15

[a] Furness, Radclyffe, High-speed tool steel. United States Patent 1233862, July 17, 1917.
[b] Furness, Radclyffe, and Patch, Richard H., Tool-steel alloy. United States Patent 1206834, Dec. 5, 1916.
[c] Shulz, E. H., Stellit und stellitänliche Legierungen. Nuere Nutzlegierungen von Metallen der Eisengruppe: Ztschr. Metallkunde, Jahrg. 16, p. 338, 1924.
[d] Parker, J. H., and De Long, B. H., Tungsten alloy tool steel. United States Patent 1233118, July 10, 1917.
[e] Molybdenum.
[f] Mn, 0.34; Si, 0.12; P, 0.02; S, 0.02.
[g] Remainder.

Cobalt is also used in making permanent magnets for magnetos, and the demand for cobalt for such purposes may increase largely. Steels for these magnets may contain as much as 60 per cent of cobalt.

A patent granted R. A. Hadfield [8] covers a steel containing about 0.25 to 1.5 per cent of carbon, and about 5 to 19 per cent of cobalt.

Tungsten (or molybdenum or vanadium) or chromium, nickel and tungsten (or vanadium or molybdenum) may also be added, and also as much as 1 per cent of manganese. The tungsten may be as much as 10 per cent and the nickel and chromium as much as 5 per cent each.

[6] Haynes, Elwood, Cobalt-chromium alloys. British Patent 100434, Jan. 5, 1916.
[7] McCurdy, Frederick T., Tool alloy containing cobalt, tantalum, and a chromium-group metal. United States Patent 1449338, Mar. 20, 1923.
[8] Hadfield, R. A., Alloys. British Patent 164039, Nov. 28, 1919.

Another patent [9] covers a similar alloy, but with cobalt ranging from about 20 to 60 per cent, preferably about 35 per cent. Other metals may be present—Tungsten, 0.5 to 20 per cent; molybdenum, 0.2 to 15 per cent; chromium, 0.3 to 10 per cent; or vanadium or a "like metal." The carbon may be 0.3 to 2 per cent.

The firm, [10] patented another magnet steel with the same range of cobalt content, and also containing 0.3 to 10 per cent of chromium and 0.3 to 2 per cent of carbon.

F. M. Becket, [11] patented an alloy for magnet steels containing 30 to 40 per cent of cobalt, 55 to 65 per cent of iron, and 3 to 6 per cent of silicon. The alloy is described as having very low hysteresis and very high magnetic-saturation value.

A little cobalt is used in wire for electrical work, and cobalt enters into a number of resistance alloys. These include cochrome, 60 per cent cobalt, 12 per cent chromium, 24 per cent iron, and 2 per cent manganese; cobalt-nickel, 20 to 30 parts of cobalt, 80 to 70 parts of nickel, and 2 parts of manganese; and Schenchs resistance alloy, 70 per cent nickel, 14 per cent cobalt, 8 per cent titanium, and 8 per cent copper or manganese, or a mixture of the two (both may be omitted and the percentages of the other metals may vary widely).

Besides the stellites, cobalt is known to be used in more than a dozen other alloys intended to resist corrosion. These alloys carry 3.7 to 62 per cent of cobalt. Some alloys are particularly intended to withstand temperatures above red heat. Two of them have the following respective specifications:

Specifications for corrosion-resisting steels, in per cent

	1 [a]		2 [b]	
	Preferred combination	Allowable variations	Preferred combination	Allowable variations
Iron	70.0	55.0–75.0	26.0	
Chromium	15.0	10.0–20.0	12.0	[c] 5–30
Cobalt	13.5	10.0–20.0	[d] 60.0	50–90
Manganese	.5	.2– 1.0		
Silicon	.5	.2– 3.0		
Carbon	.5	.2– 3.0	0.4	

[a] Fahrenwald, Frank A., Iron-cobalt chromium alloy. United States Patent 1357549, Nov. 2, 1920.
[b] Henderson, John C., Alloy for articles exposed to high temperatures. United States Patent 1190652, July 11, 1916.
[c] Combined chromium and nickel or cobalt must equal 60 per cent.
[d] Nickel or cobalt.

A British patent [12] that covers the use of cobalt in a bearing metal gives the following limiting percentages: About 70 to 75 per cent of lead; 15 to 25 per cent of antimony; 3 to 6 per cent of tin; 1 to 3 per cent of cobalt; and 0.6 to 1.5 per cent of copper.

Some cobalt is used as cobalt linoleate and in other organic compounds as driers for paint.

[9] Sumitomo Chukosko (Ltd.), Permanent magnets, alloys. British Patent 118601, July 2, 1918.
[10] Sumitomo Chukosko (Ltd.), Permanent magnets, alloys. British Patent 118602, July 2, 1918.
[11] Becket, F. M., Alloy containing iron, cobalt, and silicon. United States Patent 1247206, Nov. 20, 1917.
[12] Th. Goldschmidt Akt.-Ges., Alloys. British Patent 172003. Nov. 18, 1921.

Little is known of the total quantity of cobalt used except that the quantity imported into the United States probably represents that used in this country.

IMPORTS OF COBALT

The imports of cobalt metal, ores, and compounds into the United States during the last six years are shown in the following tables:

Cobalt ore, cobalt, zaffer, and oxide imported for consumption in the United States, 1919–1924

Year	Ore		Cobalt		Zaffer		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1919	17,045	$2,832	60,511	$141,450			131,424	$184,751	208,980	$329,033
1920	13,039	4,794	143,603	326,864	220	$14	202,724	399,605	359,586	731,277
1921	7,657	3,235	38,442	105,539			164,003	342,426	210,102	451,200
1922	5,195	7,075	126,364	321,396			217,530	435,895	[a]349,089	[a]764,366
1923	58,719	56,326	225,639	552,434			258,574	511,903	[a]542,932	[a]1,120,663
1924	28,786	37,276	118,952	264,935			226,703	440,898	[a]374,441	[a]743,109

[a] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to new tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356, and in 1924, 797 pounds, valued at $856.

Cobalt compounds imported for consumption in the United States, 1923–1924

	1923		1924	
	Pounds	Value	Pounds	Value
Linoleate	3,617	$1,140	40	$22
Sulphate	39,691	24,597		
Other salts	2,336	1,619	757	834
	45,644	27,356	797	856

Cobalt and cobalt ore imported into the United States, 1923–1924, by countries

Country	1923		1924	
	Pounds	Value	Pounds	Value
Australia	38,772	$10,112	12,786	$12,709
Belgium	278	66		
Canada	175,189	442,740	112,752	251,332
England	70,108	155,818	22,200	38,170
Germany	11	24		
	284,358	608,760	147,738	302,211

TESTS FOR COBALT

The commonest cobalt minerals—linnæite (Co_3S_4), generally containing also some nickel and iron; smaltite ($CoAs_2$); cobaltite (CoAsS); and erythrite ($Co_3(AsO_4).8H_2O$)—may be easily tested by heating a fragment of the mineral in a bead of borax or of salt of phosphorus before the blowpipe. A very small quantity of cobalt will give a beautiful blue color to either bead, even in the

presence of considerable quantities of copper, iron, and nickel. If copper and nickel interfere, the bead may be heated on charcoal in the reducing flame with a granule of tin, thus reducing the nickel and copper to the metallic state, after which the flux will show the blue cobalt color. Iron, when in sufficient quantity to interfere, must be removed by solution and precipitation.

Linnæite, smaltite, and cobaltite are silvery-looking minerals not easily distinguished from some other metallic minerals until they become well known, but erythrite has a beautiful and very characteristic peach-blossom color.

MOLYBDENUM

Both of the two largest molybdenum-mining companies of this country worked their mines for at least part of 1924. Together they produced 21,251 short tons of ore, containing 297,174 pounds of molybdenum. The Molybdenum Corporation of America, which had operated its molybdenite mine on Sulphur Gulch, 7 miles east of Questa, N. M., during the last two months of 1923, continued mining through 1924. The Climax Molybdenum Co., which had been filling orders from ore and ferromolybdenum on hand and from imported ore, found the demand sufficient to warrant resumption in August of mining and milling on its property at Climax, about 12 miles north of Leadville, Colo., which had been shut down since April, 1919.

The Molybdenum Corporation of America mines an ore which, as selected in the workings, carries about 4 per cent Mo. The ore occurs in masses the flakes of which are so small as to be indistinguishable. It follows fault planes and has all been crushed and more or less mixed with the gouge of the fault. Although of comparatively high grade, the masses of ore are small. The ore of the Climax Molybdenum Co., on the other hand, is comparatively lean, carrying an equivalent of 0.92 per cent MoS_2, in which is included, however, 0.25 to 0.30 per cent MoO_3 contained in molybdite ($2FeO.6MoO_3.15H_2O$). The molybdenite occurs in exceedingly small flakes along innumerable quartz veinlets. The ore is in huge quantity and in a single body, so that it can be mined very cheaply.

No other molybdenum mines are known to have been worked in the United States during the year, though great numbers of claims have been located in widely spread localities. In Canada some molybdenite concentrate was produced, and the Kvina molybdenum mine near Christiansand, Norway, is reported to have been making the repairs necessary after a shut down of five years, preliminary to resumption of operations in 1925.

So far as is known the present use of molybdenum in steel (which is by far the most important use) is confined to the addition of 0.25 to 0.75 per cent to steel as a toughener, taking the place of nickel and possibly of vanadium. Although this use has developed to a point that allows the companies mentioned to work their mines, for the time being the market seems too small to warrant the opening of other mines.

Molybdenum in ore and concentrates, produced in the United States, sold in 1917–1924

Year	Pounds	Value	Year	Pounds	Value
1917	350, 200	$495, 350	1921		
1918	861, 637	1, 253, 700	1922		
1919	297, 926	341, 814	1923	22, 667	(a)
1920	34, 900	17, 207	1924	297, 174	(a)

a Not reported.

"Molybdenum ore[a] (steel-hardening)" imported for consumption in the United States, 1918–1924

Year	Pounds	Value	Year	Pounds	Value
1918, July to December [b]	140, 222	$123, 924	1922	412, 221	$90, 015
1919	106, 743	77, 572	1923 [c]	16, 671	13, 115
1920	15, 639	9, 707	1924 [c]	10, 379	9, 038
1921	29, 783	20, 471			

[a] 1918–1922, recorded as molybdenum ore; 1923–24, recorded as molybdenum content of ore.
[b] Not separately classified prior to July, 1918.
[c] Classification under new tariff in effect Sept. 22, 1922, "Molybdenum ore and concentrates (molybdenum content)."

The country of origin of the imported ore is not known.

The tariff act of 1922, paragraph 302, provides a duty of 35 cents per pound on the metallic molybednum contained in molybdenum ore or concentrates and 50 cents per pound and 15 per centum ad valorem on molybdenum powder, calcium molybdate, and all other compounds and alloys of molybdenum.

TESTS FOR MOLYBDENUM

Three molybdenum minerals are fairly common—molybdenite, wulfenite, and molybdenum ocher. Molybdenite (molybdenum sulphide, MoS_2), containing 60 per cent molybdenum, occurs in thin, bright lead-colored flakes which bend readily but are not elastic and are easily scratched by the finger nail. The flakes may be so minute that they coat a surface like paint or they may be several inches across, and they may be regularly bounded by straight lines and piled up into doubly terminated hexagonal crystals. The mineral, however, is more likely to be found in irregular lumps, easily cleavable into thin leaves. Its specific gravity is about 4.5. Molybdenite is associated with many kinds of rocks and veins, but occurs most plentifully in association with granitic rocks. The deposits are invariably pockety.

Wulfenite (lead molybdate, $PbMoO_4$) contains 39.3 per cent MoO_3. It usually occurs as lustrous resinous yellow, orange, or red tetragonal crystals in the oxidized parts of lead deposits. It may be greenish or brownish, grayish, whitish, or colorless. The crystals are generally platy with right-angled corners, but may be nearly cubes or double pyramids built on square plates. The mineral is very brittle. It has a hardness of 2.75 to 3 and a specific gravity of 6.7 to 7.

Molybdite, or molybdenum ocher (hydrous ferric molybdate, $2FeO.6MoO_3.15H_2O$), generally forms a bright-yellow powdery mineral, though it also appears in small radial crystals. It is a product of the weathering of molybdenite, but is seldom found in sufficient quantity to be of commercial value.

Powellite (calcium molybdate, $CaMoO_4$) is usually a white or grayish mineral formed by the alteration of molybdenite, but it sometimes occurs in small yellowish transparent to translucent octahedrons. In some specimens tungsten replaces part of the molybdenum. Like molybdite, it is not found in deposits large enough to be of commercial value.

Any of these minerals except molybdenite may be tested by heating a small piece in a porcelain crucible (a particle less than half the size of a grain of wheat is enough) with a drop of sulphuric acid until the fumes have nearly ceased. When the crucible has cooled it will have a beautiful deep-blue coating as soon as it has absorbed enough moisture.

Molybdenite must be oxidized before it can be tested in this manner. It may be oxidized either by boiling it to dryness with 2 or 3 drops of nitric acid or by powdering and roasting it in the air for a few minutes. The sulphuric acid is then added and the test is performed as indicated.

NICKEL

In 1924 the United States as usual produced nickel only as a by-product of electrolytic refining of both domestic and foreign blister copper. Most blister copper contains a little nickel, which gradually accumulates in the electrolyte as the copper passes from the anode to the cathode. How small a percentage of nickel is present in the copper is strikingly shown by the respective figures of production. During 1924, 1,038,200 short tons of new electrolytic copper was produced by the refineries. From the electrolytes was recovered 381,258 pounds of nickel contained in nickel sulphate, in which form the metal is marketed. The nickel equals 0.018 of 1 per cent of the refined copper produced, or about 1 pound of nickel to each 2.7 tons (5,446 pounds) of copper. It was valued as $114,903.

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1919–1924, and from mixed ores in 1919 and 1920

Year	Short tons	Value	Year	Short tons	Value
1919 [a]	511	$434,485	1922	208	$133,191
1920 [a]	365	293,250	1923	100	71,605
1921	111	86,000	1924	191	114,903

[a] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

Most of the nickel used in the United States is mined in the Sudbury region, Ontario, Canada. The mines and smelters now operating are owned by two companies—the Mond Nickel Co., of England, and the International Nickel Co., of New York. Of these the second is by far the larger.

Concerning the nickel industry in Ontario in 1924 Rogers and Young[13] say:

That the recovery in activity both in mining, smelting, and refining in the nickel-copper industry, which was noted in the last annual statement, has gained momentum, is evidenced by the statistics for 1924 collected from the several operators. When it is remembered that one company, the British American Nickel Corporation, went into liquidation in July, the recovery noted is all the more creditable. Despite the loss of the large market in nickel armor plate, curtailed by the Washington Disarmament Agreement, production closely approached that of 1918, the war year of maximum output. The advance may be accounted for in the new and unusual industrial uses to which the nickel has been put. A few of these might be mentioned: Nickel cooking utensils, seamless and welded nickel tubes and fittings, also alloys such as Monel and Mond metal, which are noncorrosive and suited for many purposes.

There are now two plants in the United States, one a subsidiary of the Mond Nickel Co., near Clearfield, Pa., and the other owned and operated by the International Nickel Co., at Huntington, W. Va., equipped for the fabrication of nickel in various forms.

During the period the International Nickel Co. and the Mond Co. operated the full 12 months, while the British American ceased about July 23. The Mond Co. successfully introduced magnetic separation for mixed ores by means of an inclined conveyor belt, and in addition has announced the installation in 1925 of an acid plant to recover sulphur fumes, heretofore lost. Mining and smelting operations for the last pre-war year, the year of maximum output, and also for the past four years, are noted in the table which follows:

Nickel-copper mining and smelting, in tons

Schedule	1913	1918	1921	1922	1923	1924
Ore raised	784,697	1,643,040	262,593	259,569	1,187,354	1,411,980
Ore smelted	823,403	1,559,892	393,768	314,120	1,140,160	1,308,694
Bessemer matte produced	47,150	87,184	19,498	17,324	58,084	65,943
Nickel content of matte	24,838	45,886	9,128	8,678	31,029	34,638
Copper content of matte	12,988	23,843	6,323	5,422	15,769	18,490
Matte exported			10,466	19,831	21,450	26,565
Matte refined in Canada *		5,334	5,558	10,340	31,765	37,613

* Refining in Canada began at Port Colborne, Ontario, in 1918, and at Deschenes, Quebec, in 1920.

Refineries.—During the year the Port Colborne (International Nickel Co.) and the Deschenes (British Nickel Corporation) refineries recovered 25,448,868 pounds of refined nickel, 7,373,319 pounds of which was electrolytic. There was in addition an output of nickel oxide amounting to 12,064,870 pounds, containing 9,447,107 pounds of nickel. Converter and electrolytic copper totaling 17,918,911 pounds and containing 17,236,770 pounds of metallic copper was also recovered. The total selling value of these commodities, exclusive of the precious metal elements, amounted to $9,628,688. The average price of metallic nickel was 20.8 cents and of copper 12.6 cents per pound. In addition to the above metals there is, of course, the copper and nickel contained in mattes exported and lesser amounts recovered from silver-cobalt ores treated in the silver smelters of Ontario and the United States.

The Sudbury ores are high in pyrrhotite and carry some chalcopyrite. The nickel is mostly in the mineral pentlandite, usually distributed through the mass in such small grains as to be invisible.

The United States Nickel Co., at New Brunswick, N. J., imports nickel matte from Belgium and reduces it to metal. The matte is made from the genthite (garnierite) ores of New Caledonia.

[13] Rogers, W. R., and Young, A. C., Preliminary Report on the Mineral Production of Ontario in 1924: Ontario Dept. of Mines Bull. 53, 1925, p. 13.

The United States has a number of small deposits of nickel-bearing rocks, but none are large enough, or, failing great size, rich enough to compete with the Canadian deposits. A group of deposits in southeastern Alaska has recently been described by A. F. Buddington.[14]

The United States has imported and exported nickel as follows:

Nickel imported for consumption in the United States, 1918–1924

Year	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.		Manufactures and nickel sheets and strips	Total value
	Pounds	Value		
1918	73,207,147	$11,520,775	$115,243	$11,636,018
1919	36,562,388	8,334,135	90,451	8,424,586
1920	48,492,076	10,657,193	200,464	10,857,657
1921	4,396,119	1,210,317	107,155	1,317,472
1922	14,919,362	3,945,168	110,176	4,055,344
1923	40,669,203	6,601,995	92,977	6,694,972
1924	36,918,980	6,132,984	66,207	6,199,191

Nickel imported for consumption in the United States, 1922–1924, by classes

Class	1922		1923		1924	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel ore and matte (nickel content)	3,085,632	$396,726	14,601,820	$1,145,645	11,333,251	$1,063,084
Nickel alloys, pigs, bars, etc.	11,341,360	3,438,225	23,783,041	5,159,888	24,683,882	4,949,655
Nickel oxide	492,370	110,217	2,284,342	296,462	901,847	120,245
All other manufactures	[a]	110,176	127,324	92,977	145,785	66,207
		4,055,344	40,796,527	6,694,972	37,064,765	6,199,191

[a] Quantity not recorded prior to new tariff. Imports from Sept. 22 to Dec. 31, 1922, were 24,586 pounds, valued at $23,710.

Nickel, nickel oxide, and matte exported from the United States, 1917–1924

Year	Pounds	Value	Year	Pounds	Value
1917	21,992,820	$8,936,620	1921	425,851	$103,372
1918	17,469,500	6,927,041	1922	9,317,520	1,016,691
1919	3,810,656	1,697,544	1923 [a]	11,200	626
1920	1,215,232	574,845	1924 [a]		

[a] Nickel oxide and matte only. Separate figures for nickel not available. See following table.

Beginning with 1922, additional classes of nickel exports were shown. The complete exports for 1922 to 1924 are given in the following table.

[14] Buddington, A. F., Mineral Investigations in Southeastern Alaska: U. S. Geol. Survey Bull. 773, 1925, pp. 95–113.

Nickel exported from the United States, 1922–1924, by classes

Class	1922		1923		1924	
	Pounds	Value	Pounds	Value	Pounds	Value
Oxide and matte	9,311,680	$1,013,069	11,200	$626		
Nickel	5,840	3,022	868,158	307,269	1,915,456	$565,911
Monel metal and other alloys	913,983	196,702				
Manufactures	249,467	179,094	488,088	290,452	446,183	203,854
Nickel or German silver in bars, rods, or sheets	402,922	121,755	481,178	145,518	250,769	73,372

The following passages in the tariff act of 1922 apply to imports of nickel:

Paragraph 302. Tungsten nickel, chromium nickel, vanadium nickel, zirconium nickel, and all alloys used in the manufacture of steel not specially provided for, 25 per centum ad valorem.

Paragraph 305. Steel carrying more than six-tenths of 1 per cent of nickel, 8 per centum ad valorem in addition to the ordinary duty on the steel.

Paragraph 380. German silver, or nickel silver, unmanufactured, 20 per centum ad valorem, nickel-silver sheets, strips, rods, and wire, 30 per centum ad valorem.

Paragraph 390. Nickel oxide, 1 cent per pound; nickel, and nickel alloy of any kind in which nickel is the component material of chief value, in pigs or ingots, shot, cubes, grains, cathodes, or similar forms, 3 cents per pound; in bars, rods, plates, sheets, strips, strands, castings, wire, tubes, tubing, anodes, or electrodes, 25 per centum ad valorem; and in addition thereto, on all of the foregoing, if cold rolled, cold drawn, or cold worked, 10 per centum ad valorem.

TEST FOR NICKEL

The following directions for a test for nickel were prepared by W. C. Wheeler: Grind to a fine powder a sample, 2 or 3 grams (30 to 40 grains); treat in a test tube with a few cubic centimeters of aqua regia (a mixture of 1 part of nitric acid and 3 or 4 parts of hydrochloric acid), and boil nearly to dryness; then add enough nitric acid and water to dissolve all soluble substances. Filter if necessary. Dilute to 10 to 15 c. c. (about one-third the capacity of a test tube 6 inches long and three-fourths inch in diameter), add a gram or more (one-half teaspoon) of citric acid (solid), and dissolve by heating. Make the solution slightly ammoniacal, noting that it should contain no precipitate. To the slightly ammoniacal solution add about 2 c. c. (one-half teaspoon) of 1 per cent alcoholic solution of dimethylglyoxime. A voluminous scarlet precipitate indicates nickel.

Boil aqua regia solution nearly to dryness to remove from it the large excess of acid and anything, such as hydrogen sulphide, that would cause the precipitation of iron, cobalt, nickel, etc., in the ammoniacal solution.

The citric acid will prevent the precipitation of iron and aluminum as hydroxides, but will not prevent the precipitation of sulphides of iron, cobalt, nickel, and some other metals in the ammoniacal solution. If a brown precipitate of iron forms after the solution is made ammoniacal the solution does not contain enough citric acid.

TANTALUM

Tantalum and its close associate, columbium, are still among the experimental metals—those possessing attractive properties but not shown to have wide uses that some other and cheaper metal or alloy will not fill as well or better. Inasmuch, however, as constant experimentation is developing numberless new uses for the elements and their alloys and compounds, other uses than those now known—uses they will be particularly adapted to fill—will probably be found for these metals.

To obtain these metals in a pure state, or a state of purity comparable to that of the iron, aluminum, or copper of ordinary commerce, is difficult and tedious, though not impracticable. Like vanadium, however, they can be converted into ferroalloys with comparative ease. Several patents have been taken out for their use in steel, but the steels have been made only in experimental lots. So far as is known the steels made have all contained both tantalum and columbium, and the effect of either metal alone is therefore not known.

The only known output of ores of these metals made in the United States for several years has been that shipped by Dr. A. T. Roos, Rapid City, S. Dak., who states that the production of columbite in 1924 was 1,197 pounds, [15] valued at about $598. The columbite has come from pegmatite dikes near Keystone and Hill City, in the southern part of the Black Hills, and all the ore is thought to have been used for experimental purposes, most of it in ferro-tantalum-columbium, without separation of the two metals.

Columbite, mined in the United States, shipped in 1918–1924

Year	Pounds	Value	Year	Pounds	Value
1918	4,500	$2,250	1922	600	$240
1919	300	90	1923	1,350	540
1920	4,000	1,450	1924	1,197	598
1921	3,400	1,150			

No imports of tantalum ores were recorded in 1922. The records of the Bureau of Foreign and Domestic Commerce show that 5,600 pounds of "tantalum steel-hardening ores," valued at $3,031, were imported for consumption in 1923, but none were imported in 1924. American ores are not sufficiently free from columbium to make them suitable for the manufacture of tantalum under present processes.

The Fansteel Products Co., of North Chicago, Ill., markets a charger for storage batteries in which tantalum is used as an electronic valve. The use of tantalum in stellite has been patented.[16] Columbium has been found more difficult to isolate than tantalum, and is not known to have been put to practical use.

TITANIUM

So far as the Bureau of Mines knows the only titanium mineral produced in the United States during 1924 was ilmenite mined from

[15] Figures are published with the express permission of Doctor Roos.

[16] McCurdy, Frederick T., Tool alloy containing cobalt, tantalum, and a chromium-group metal. United States Patent 1449338, Mar. 20, 1923.

the beach sands about 4 miles south of Pablo Beach, Fla., by Buckman & Pritchard (Inc.), a subsidiary of the Titanium Pigment Co. (Inc.), which in turn is controlled by the United States Lead Co. During the year 4,769 short tons of ilmenite, presumably containing about 52 per cent TiO_2, were shipped from Pablo Beach to the plant of the Titanium Pigment Co. at St. Louis, Mo. There were also shipped from the same deposit 281 short tons of zircon.

Titanium minerals produced in the United States, 1920–1924 [a]

Year	Rutile concentrates		Ilmenite concentrates	
	Short tons	Percentage of TiO_2	Short tons	Percentage of TiO_2
1920	277	94-96	268	50
1921				
1922	310	95	5,181	52-54
1923	270	95	6,270	52
1924			4,769	52

[a] Bureau of Mines not at liberty to publish values.

The Titanium Pigment Co. formerly had a plant at Niagara Falls, N. Y., but during 1924 erected a new factory at St. Louis with a considerably increased capacity.

On the shore of Monterey Bay, near Aptos and about 12 miles southeast of Santa Cruz, Calif., the Triumph Steel Co. proposes to work titanium-bearing sands of the beach. Irregular crescents 100 or 200 feet long and as much as 50 feet wide along the foot of detrital bluffs carry layers of black sand from the thickness of cardboard to as much as 5 or 6 inches, separated by layers of lean sand through a thickness of several feet. The sand beyond the crescents is said to carry 5 per cent of black sand, though it is not evident to the eye.

The sand is said to be mostly magnetite, with some martite and 16 per cent of TiO_2 in the form of ilmenite. The separated ilmenitic part is said to carry 40 per cent of TiO_2. The present intention is to use the magnetite and martite for making muck bar by reduction without melting, and to save the ilmenite for later and different treatment. The sand was used by another company for the manufacture of pigment.

During the year the Bureau of Standards issued proposed master specifications for outside white titanium zinc paint which suggested the following ingredients for pigment:

Specifications for white titanium zinc paint for outside use

Ingredients	Maximum	Minimum
	Per cent	*Per cent*
Titanium pigment		50
Zinc oxide		40
Extending pigments	10.0	
Matter soluble in water	.8	
Lead	None.	
Sulphide sulphur	None.	

In no case shall the sum of the titanium pigment and zinc oxide be less than 90 per cent. The titanium pigment shall contain 25 per cent titanium oxide, the remainder to be blanc fixe (precipitated barium sulphate).

Many patents covering the use of titanium in alloys have been granted during recent years, but many seem to cover efforts to forestall discoveries by some one else rather than discoveries that have been tested. Ferrotitanium for use in steel, like the titanium white pigment, is made from ilmenite.

For paint only very high grade ilmenite is desired; otherwise the consumption of chemicals is increased, more iron has to be removed, and obtaining a white pigment is more difficult.

The various titaniferous iron deposits of the country, such as those of the Adirondacks,[17] Iron Mountain, Wyo.,[18] and western North Carolina,[19] are magnetites containing only intergrowths of ilmenite plates, so that they are very much leaner in TiO_2 than the Florida beach sands. The richest and best supplies of ilmenite yet found are the beach sorted materials that have been derived from weathered gneisses extensively intruded by pegmatites. Such was the origin of the ilmenite sands of Florida, Brazil, Travancore (southwest India),[20] and Ceylon.[21]

A new use for ilmenite-bearing iron ores is covered by a patent in which E. C. Eckel [22] describes the manufacture of a quick-hardening chemically resistant cement by smelting in a blast furnace titaniferous iron ore with enough lime and aluminous material to form a titanium-calcium-aluminum-iron slag, which consists essentially of calcium titanate ($TiO_2.CaO$) with subordinate quantities of ferrites, aluminates, and calcium silicate, and contains 2 to 10 per cent of iron oxide. The remainder of the iron is reduced to metal and drawn out below as in ordinary smelting. The slag, finely ground, forms "titan cement." It is claimed that if the lime is kept below 50 per cent, preferably about 30 to 40 per cent, the cement hardens rapidly after a normal set, attaining high strength in 24 to 48 hours; that at all periods it is stronger than Portland or alumina cements; and that its resistance to chemical attack is higher than that of either Portland or alumina cement. The specific gravity is given as 3.35 to 3.55.

Rutile, the natural titanium oxide, is used mostly for arc-light electrodes and for potassium-titanium oxalate to be used in dyeing and in the manufacture of leather, but the demand is small. There can not be said to be a market price for titanium minerals, as the buyers are so few. Ilmenite may, perhaps, be said to be worth $10 to $25 per short ton for material carrying about 52 per cent TiO_2, if a buyer can be found. Concentrated rutile sells at 10 to

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[17] Kemp, J. F., "The titaniferous ores of the Adirondacks": U. S. Geol. Survey 19th Ann. Rept., 1897, pp. 377–422.

[18] Ball, S. H., Titaniferous Iron Ore of Iron Mountain, Wyo.: U. S. Geol. Survey Bull. 315, 1907, pp. 206–212.

[19] Nitze, H. B. C., Iron Ores of North Carolina; a Preliminary Report: North Carolina Geol. Survey Bull. 1, 1893, 239 pp.

[20] Masillimani, E., and Chacko, C. I., Report Travancore Geological Survey. 1907–1910. Tipper, G. H., The monazite sands of Travancore: Recs. Geol. Surv. India, vol. 44, 1914, pp. 186–195.

[21] Imperial Institute, London, Recent work on monazite and other thorium minerals in Ceylon: Vol. 14, 1916, pp. 321–369.

[22] Eckel, E. C., Cement and iron. United States Patent 1511323, Oct. 14, 1924.

25 cents per pound, depending on quality, quantity, fineness of grinding, and above all, on the needs of the buyer and seller.

Imports of "titanium-potassium oxalate and all compounds and mixtures containing titanium" in 1924 amounted to 24,134 pounds, valued at $3,639. In 1923 they were 39,763 pounds, valued at $6,423. In 1922, after September 22, when the new tariff became effective, the imports were 82,544 pounds, valued at $20,596. They were not separately recorded prior to the new tariff.

The tariff act of 1922 provides duties (par. 91) thus: "Titanium potassium oxalate, and all compounds and mixtures containing titanium, 30 per centum ad valorem." Paragraph 302 provides for a duty on many ores, concentrates, and alloys, among them a duty of 25 per cent ad valorem on ferrotitanium and titanium.

TUNGSTEN

The year 1924 saw a considerable increase in the quantity of tungsten ore produced in the United States over other annual outputs since the Great War, but the tonnage was still small compared with that of the 10 years preceding the close of the war, and amounted to only 374 short tons, which sold for $200,000. Besides the ore produced during the year, 191 tons of ore that had been held several years was sold for $87,000.

The table that follows shows the production of tungsten ores since 1900, which practically marked the beginning of tungsten mining in this country, and the average price per unit. The average prices are surprisingly low in view of the great fluctuation in the market quotations. Thus in 1907 $15 per unit was paid for some ore, in 1917 more than $100 per unit, and in 1918 a considerable quantity of ore was sold at $75 per unit. On the other hand, in 1900 and 1901, some ores sold for less than $2 per unit.

Concentrated tungsten ores (reduced to an equivalent of 60 per cent WO_3) produced in the United States, sold in 1900–1924, with the average price per unit

Year	Short tons	Value	Average price per unit	Year	Short tons	Value	Average price per unit
1900	46	$11,040	$4.00	1913	1,537	$672,118	$7.24
1901	[a] 179	27,720	2.58	1914	990	435,000	7.32
1902	[a] 184	34,040	3.08	1915	2,332	4,100,000	29.30
1903	[a] 292	43,639	2.49	1916	5,923	12,074,000	33.98
1904	[a] 740	184,000	4.12	1917	6,144	6,783,000	18.40
1905	[a] 803	268,676	5.57	1918	5,061	7,049,300	23.24
1906	928	348,867	6.26	1919	327	353,900	18.02
1907	1,640	890,048	9.04	1920	216	101,800	7.86
1908	671	229,955	5.71	1921			
1909	1,619	614,370	6.32	1922			
1910	1,821	832,992	7.68	1923	241	144,600	[b] 10.00
1911	1,139	407,985	5.97	1924	[c] 565	[c] 287,000	8.47
1912	1,330	502,158	6.27				

[a] For the years 1901 to 1905 the tungsten content of the concentrates is estimated.
[b] The output of 1923 was made by one company only, which sold to its owners at a price considerably above the market.
[c] Includes 191 tons produced in 1919, sold in 1924 for $87,000.

In 1924 the Wolf Tongue Mining Co., the only company mining tungsten in Colorado, worked the Cold Spring mine near Nederland, but conditions were not encouraging. All concentrates were

taken by the parent organization, the Firth-Sterling Steel Co., McKeesport, Pa., as in 1923, at a fixed price. The concentrates averaged about 55 per cent WO_3. Although $10 per unit was offered for ores all through the year, only about 25 tons were produced by lessees and from other mines. The ore is ferberite (iron tungstate).

In Nevada the C. W. Poole Co. leased the contact metamorphic scheelite deposits of the Pacific Tungsten Co., near Mill City, Nev., and operated the mine and mill during the last half of the year. On the east side of the Nightingale Range, which lies along the east side of Lake Winnemucca, 48 miles west of Lovelock, the Pacific Smelting & Metals Corporation, of Lovelock, Nev., spent the year erecting a mill and preparing to mine a contact metamorphic deposit of scheelite. The mill is planned for a capacity of 150 tons a day. As at Mill City, the ore is heavily impregnated with iron sulphide below the water level and must be separated magnetically.[23]

In August the Lezeart Coal Mines Syndicate, of Evanston, Wyo., took over the exploitation of the contact metamorphic deposits in the Pilot Range, 23 miles east and a little south of Mina, Nev., controlled by S. Summerfield, of Mina. A dry concentration mill with a capacity of 30 tons of ore a day, quarters for 18 men, a laboratory, an office, and a warehouse were erected. At the end of the year the mill was about ready for operation.

The Tungsten Products Co. (not related to the companies of the same name formerly operating in Boulder, Colo., and Baltimore, Md., respectively), of Bishop, Calif., now controls the Blizzard claims, covering most of the contact metamorphic scheelite deposits near the head of Morgan Creek, 24 miles by road and trail west and a little north of Bishop. The company has done considerable work on the property. The outcrop is at an altitude of 11,400 or 11,500 feet. Snow sometimes is very deep (5 to 15 or even 20 feet) at this altitude, and ordinarily lasts from November to the middle of June, making mining during the winter impossible. An adit 1,300 feet long and 400 feet below the outcrop was driven during 1923 and 1924 in order to get below the snow and make winter operation possible. It was hoped to cut the tactite (limestone altered to garnet, epidote, scheelite, and other minerals) at this depth, but raising to within 60 feet of the surface was necessary. As has been often proved, no estimate of tactite ore can be relied on unless the ore is exposed on four sides within a short distance of each other.

A report on the property by Hugh M. Roberts, of the E. J. Longyear Co., dated October 4, 1917, and kindly loaned to the writer by A. B. Leach & Co. (Inc.), estimated the ore in sight as 100,000 tons carrying 1.02 per cent WO_3 and 186,800 tons carrying 0.44 per cent WO_3. The ore carries some copper, which is to be eliminated before the concentrates are sold. Automobiles can be driven within 4 miles of the mine, but for the last three miles the trail is difficult and steep, even for pack or saddle animals.

The mill was overhauled and put in working order in 1924. It was built when prices were very high and haste was necessary, and it had been damaged by snow. A power line 16 miles long was erected,

[23] For a description of the contact metamorphic scheelite deposits mentioned in this article, see Hess, Frank L., and Larsen, Esper S., Contact metamorphic tungsten deposits of the United States: U. S. Geol. Survey Bull. 725, 1921, pp. 245–309.

and the mill is driven by electricity. The erection of the mill in the valley of Pine Creek, where snow would never bother and where automobile trucks could be driven, has been considered. A tram line about 12,000 feet long with a fall of 4,000 feet would be required to transport the ore from the mine. The country is too rough to allow the construction of a road at a practicable cost.

The Atolia Mining Co. operated its mine in 1924 only through lessees, the company milling the ore mined. No other property is known to have been worked in the district during the year.

China still is the important factor in tungsten production, and except when the tungsten is produced as a by-product probably no other country can compete in the open market with its easily mined ore. Although civil war prevented work on the deposits in north and northwest Kwangtung, the deposits in Kiang-si furnished possibly 3,000 long tons, carrying 67.5 per cent WO_3 (3,600 short tons of 60 per cent WO_3). The large alluvial deposits of Shai Wai Shan, near Nananfu, Kiang-si, are practically exhausted and the production in that field is now from quartz veins.

STOCKS AND PRICES

Few exact data concerning stocks are available, but it is thought that at the end of the year steel makers in general had on hand almost if not quite a year's supply. The marketable stocks were considerably reduced during the year, the steel makers not wishing to cut deeply into their own reserves.

WORLD'S PRODUCTION

The world's production of tungsten as shown by the ores shipped or marketed from 1916 to 1924, inclusive, so far as statistics are available, is shown in the following table compiled by W. I. Whiteside, of the Bureau of Mines, from official reports.

World's production (as shown by sales or exports) of tungsten ore, 1916–1924, by metallogenic provinces and political areas, in metric tons (2,204.6 pounds) of concentrates containing 60 per cent of WO_3

[Leaders (----) in this table indicate that no data are available to the Bureau of Mines]

Province and area	1916	1917	1918	1919	1920	1921	1922	1923	1924
ASIA									
Japo-Korean province:									
Japan	730	763	629	574	170	None.	None.	None.	----
Chosen (Korea)	555	919	1,100	197	5	(a)	14	----	----
Chino-Malayan province:									
China	109	1,361	10,577	2,654	4,712	2,657	3,873	4,554	3,398
Tonkin	343	433	378	284	284	452	112	129	150
Burma and Shan States	3,464	4,226	4,138	3,623	2,983	673	1,038	960	814
Siam	530	726	231	258	137	76	None	(a)	None.
Unfederated Malay States	317	334	1,156	808	296	12	258	393	214
Federated Malay States	567	837	391	480	257	60	104	41	107
Dutch East Indies	47	8	7	None.	161	None.	----	----	----
Indian province: India (excluding Burma)	46	68	44	1	None.	None.	None	None.	None.
	6,708	9,675	18,651	8,879	9,005	3,930	5,399	6,077	4,682

a Less than one-quarter ton.

World's production (as shown by sales or exports) of tungsten ore, etc.,—Contd.

Province and area	1916	1917	1918	1919	1920	1921	1922	1923	1924
AUSTRALIA									
Australian province:									
Queensland	519	471	357	344	119	5	4	None.	1
Northern Territory	137	252	280	278	245	None.	19	None.	None.
New South Wales	313	268	279	237	39	------	None.	2	10
Victoria	17	28	5	3	9	------	------	------	------
South Australia	(a)	(a)	None.	None.	None.	None.	None.	None.	None.
Tasmania	126	286	440	379	209	12	21	116	64
Western Australia	5	1	6	8	3	------	------	------	------
	1,117	1,306	1,367	1,249	624	17	44	118	75
OCEANIA									
Oceanic province: New Zealand	306	235	170	146	47	46	None.	6	4
SOUTH AMERICA									
Cordilleran province:									
Chile	2	None.	None.	None.	None.	None.	None.	None.	None.
Argentina	854	1,085	614	204	182	52	125	144	137
Bolivia	3,288	4,215	3,703	2,161	766	174	9	None.	18
Peru	532	427	256	139	77	2	None.	None.	------
Brazilian province: Brazil	5	------	------	------	------	------	------	------	------
	4,681	5,727	4,573	2,504	1,025	228	134	144	155
NORTH AMERICA									
Southwest American province:									
Mexico	159	308	239	103	82	37	None.	None.	None
United States	5,330	5,545	4,578	297	196	None.	None.	219	513
Alaskan province: Alaska	43	29	13	None.	None.	None.	None.	None.	None.
Canadian province: Southeastern Canada	------	------	15	None.	None.	None.	None.	None.	None.
	5,532	5,882	4,845	400	278	37	None.	219	513
EUROPE									
Scandinavian province:									
Norway	1	1	2	None.	None.	None.	None.	None.	None.
Sweden	None.	None.	3	30	5	None.	None.	None.	None.
Franco-Cornish province:									
England	407	255	307	177	83	------	3	2	2
France	162	261	45	70	23	------	------	------	------
Iberian province:									
Portugal	1,418	1,580	1,150	706	237	306	527	289	304
Spain	425	446	534	302	57	25	None.	9	200
Italy	5	1	------	------	------	7	None.	1	------
Erzgebirge province:									
Germany	115	295	196	145	45	27	42	40	13
Austria	51	(b)	------	(c)	(c)	(c)	(c)	(c)	(c)
Czechoslovakia	(d)	(d)	(d)	70	48	35	28	28	66
Russian province: Russia	34	104	------	------	------	------	------	------	------
	2,618	2,943	2,237	1,500	498	400	600	369	585
AFRICA									
South African province:									
Southern Rhodesia	2	11	37	20	17	17	44	None.	24
Union of South Africa	2	18	37	9	None.	None.	None.	None.	None.
Nigeria	------	------	------	32	------	------	------	------	------
	4	29	74	61	17	17	44	------	24
	20,966	25,797	31,917	14,739	11,494	4,675	6,221	6,933	6,039

[a] Less than one-quarter ton.
[b] 93,136 tons ore reported mined, WO_3 content not known.
[c] See under Czechoslovakia.
[d] Included with Austria.

FIELD TEST FOR TUNGSTEN

In general, tungsten minerals are found in regions of granitic rocks, though some are found where such rocks do not show at the surface in close connection with tungsten veins. The tungsten pro-

duced in the United States and in other countries is obtained almost wholly from the areas of quartzose granular igneous rocks or from areas intruded by them.

The mineral to be tested should first be finely pulverized and then digested with hydrochloric (muriatic) acid. This test may be made in any receptacle which is not attacked by the acid—a tumbler, bottle, teacup, or test tube. If the mineral is scheelite the digestion will need to be carried on only a few minutes, but wolframite, hübnerite, or ferberite should be boiled for 10 to 20 minutes, or be heated to a lower temperature for a longer time. If the specimen tested contains tungsten minerals a yellow powder, tungsten trioxide (WO_3), will be produced, but its color may be masked by iron or other impurities. On the addition of metallic zinc the solution will turn indigo blue if enough tungsten trioxide has been formed. The depth of the color, and even the color itself, will depend largely on the degree of the digestion and the quantity of tungsten in the specimen tested. If only a little tungsten trioxide has been formed the blue will be light or even indistinguishable, and will be followed by violet and later by brown. If a considerable quantity of the trioxide has been formed the blue will be very deep and the violet will probably not appear, a muddy brown color succeeding the blue more or less quickly. Metallic tin, a piece of "tin" from a "tin" can, or even a piece of solder, may be used instead of zinc, but these do not act so readily, and the reactions, except with pure tin, are not always so satisfactory.

RADIUM, URANIUM, AND VANADIUM

Little mining primarily for radium was done in the uranium-vanadium fields of the United States in 1924, though significant work was done on vanadium. As the uranium ores were practically all used by the United States Radium Co., and only two companies produced vanadium salts, no figures for domestic production may be given.

Uranium and vanadium ores shipped from mines in the United States, 1920–1924 [a]

Year	Ores		Radium isolated (grams)	Estimated content of ores		
	Short tons	Approximate value as ore		Radium (grams)	Uranium (short tons)	Vanadium (short tons)
1920	35,076	$2,401,000	32.539	43.4	143.5	526.7
1921	8,540	876,000	35.693	33.0	109.0	201.5
1922	929	166,016	24.189	7.0	23.2	25.9
1923	2,025	150,000	12.212	5.5	18.2	63.3

[a] Bureau of Mines not at liberty to publish figures for 1924.

Of the principal companies formerly mining these ores only the United States Radium Co., 30 Church Street, New York City, isolated radium or mined ore. It leased the carnotite-bearing property of the Keystone Metals Reduction Co., on Polar Mesa, north of the La Sal Mountains, Utah, and did some mining, but the deposits

are reported to have proved much leaner than the drilling records indicated, and operations were stopped early in the fall.

Lessees mined some ore on the United States Radium Co.'s property in Long Park, Colo., and a little ore, mined by others in the neighborhood, was all bought by the company. The company also bought ore produced by Oberto and Lewis from the claims of the Radium Corporation of Colorado on Calamity Creek, near Gateway, Colo., and from the Yellow Circle Mining Co., which mined some ore from the southwest side of the La Sal Mountains. The last-named company also shipped some rich ore for medicinal use.

During the year a little carnotite was discovered at the west end of the Vulture Mountains, 7 or 8 miles southeast of Aguila, Ariz., and near the east side of Ballard's Peak, 6 or 7 miles north and a little west of Aguila. Both seem to be connected with tuff (volcanic ash). The specimens so far seen do not indicate commercial importance.

The United States Vanadium Co. leased the vanadium claims on East Rifle Creek, about 11 miles north and east of Rifle, Colo., and built a mill at Rifle, but no output is known to have been made before the close of the year. The ore is sandstone containing a microscopically flaky micaceous mineral that may be roscoelite, and the company intended to make a fused vanadium oxide, to be reduced to ferrovanadium in the East.

The United States Co. (not related to the United States Vanadium Co.) took over part of the claims controlled by the Radium Corporation of Colorado on the south side of Dry Wash, 22 miles northeast of Monticello and 40 miles southeast of Moab, Utah, and a mill with an estimated capacity of 20 tons per day was erected near the claims. It was intended to concentrate the ores, somewhat as was done by the Standard Chemical Co. in its mill on the San Miguel River, Colo., 65 miles west and north of Placerville. The mill was not ready for operation at the close of the year. It is about 80 miles from Thompsons, the nearest railroad station, on the Denver & Rio Grande Railroad.

The Pittsburgh Radium Co. at Denver made iron vanadate from ores shipped from Yellow Cat Wash, about 18 or 20 miles east of Thompsons.

At Goodsprings, Nev., the Master Alloy Mining & Milling Co. endeavored during the year to produce vanadinite concentrates; it erected and operated part of the year a small mill on one of the Ewing claims called the Spelter, 8 or 9 miles northwest of Goodsprings, Nev. No concentrate is known to have been shipped.

The Ahumada Lead Co., owning and operating the Ahumada and Erupcion mines near Ahumada, Chihuahua, Mexico, developed in the course of its lead mining during the year a large tonnage of vanadinite carrying 5 to 12 per cent V_2O_5. No production was made, but the ores will undoubtedly reach the market at a later date.

The radium market was dominated by the output from the Belgian Congo in 1924 quite as much as in 1923. Exports of uranium ore from the Belgian Congo in 1922 were 238 metric tons, and in 1923 478 tons.[24] In 1923 3,856 tons of ore were mined.[25] The uranium or radium content has not been given, but statements by per-

[24] Mining Journal, London, Minerals in Belgian Congo: Vol. 148, Jan. 3, 1925, p. 19.
[25] Figures courteously furnished by the Belgian Government.

sons having some knowledge of the ore, though not connected with the company, are that the ore shipped carries from 40 to 70 per cent U_3O_8, but the ore mined is undoubtedly in part much leaner. As each per cent means about 2.57 mg. of radium per ton of ore, it is easily seen that the total in the mined ore is very large.

The treatment plant at Oolen, Belgium, began work in 1922, and 2.7 grams of radium (Ra.) were turned out in December. It is said that in 1923, 48 grams were isolated. No figures are at hand for production in 1924, but the plant did not run the whole year, and 20 grams are known to have been placed in Europe, North America, and Australia. The total sales to the end of 1924 are said to have been 35 grams.[26] The costs are not given, but are said to be only a few dollars per milligram.

This competition, as is well known, caused the closing down of nearly all work on radium deposits in the United States. As the difficulty was insuperable and could not be foreseen, a bill[27] was introduced in Congress asking that owners of carnotite claims be freed from assessment work on their claims for three years. After hearings before the Committee on Mines and Mining of the House of Representatives the bill was favorably reported but was not acted on.

In Russia work on the radium mines was continued during the first of the year, but how much longer has not been reported.

> Since the beginning of mining operations in the Soviet mines at Tuya-Mujunsk, in the Ferghana territory, July, 1923, approximately 440 tons of raw ore have been mined. Of the total output about 167 tons were concentrated by hand dressing, with an estimated content of 1.467 grams of radium to the ton [*sic*]; the balance of 250 tons, with an estimated content of 0.571 gram, will be concentrated by mechanical processes. Further prospecting resulted in the discovery of 43 new deposits of somewhat radioactive barite and copper barite ore. The total deposits of ore in these deposits are estimated at from 1,600 to 3,200 tons, the richest radium-bearing ores being found at a depth of from 60 to 70 meters.[28]

Czechoslovakia felt the Katanga competition keenly. The Mining Journal of London[29] said:

> It is reported that, owing to the diminished demand and to the discovery of radioactive ore in America and the Congo, a loss of 80,000,000 kronen has been made on the Joachimsthal stock of radium, the price of which has fallen from 11,000,000 to 3,000,000 kronen per gram, and that the Czechoslovakian Government have abandoned the project of a State monopoly.

In Cornwall the Société Industrielle du Radium operated the South Terras mine and treated the ores in its factory at the mine. The ore had formerly been treated at Gif, near Paris. In June it was reported [30] that about a gram had recently been produced and sold. The tailings are shipped to France to be used as a fertilizer. In this country the bulk of opinion has been that no good effect has been obtained from radioactive substances as fertilizers.

Some work is reported to have been done on the radium deposits of Portugal, but no details are at hand.

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[26] Buttgenbach, H., Minéralogie du Congo belge. Brussels, 1925, p. 62.
[27] H. J. Res. 142, introduced by Hon. George F. Brumm.
[28] Commerce Reports, "Radium ore mined in Russia": Mar. 2, 1924, p. 567. The statement that the ore carries 1.467 grams of radium per ton is plainly in error, and probably means that the 167 tons contain 1.467 grams of radium.
[29] Mining Journal, London: Vol. 157, Oct. 25, 1924, p. 839.
[30] Mining Journal, London: Vol. 156, June 21, 1924, p. 52.

At the end of the year the Radium and Rare Earths Co. was reported to be preparing to start work in South Australia on the complex uranium-bearing lodes at Olary and Mount Painter.

The Vanadium Corporation of America, which owns the deposits of patronite (vanadium sulphide) at Minasragra, Peru, dominated the vanadium markets in 1924, but not as completely as the Union Minière du Haut-Katanga dominates the radium market. The company operated its smelter at Bridgeville, Pa., during the whole year. It also bought the entire stock and assets of the United States Ferro Alloys Corporation, at Niagara Falls. In Peru it finished a narrow-gauge railroad from Lake Pun-Run to the Central of Peru Railroad, eliminating the transportation of ores on llamas.

By a decree of September 3, published in El Peruano,[31] September 9, 1924, vanadium minerals and their chemical and physical concentrates exported from Peru, whatever their grade, are made subject to a duty of $1.50 per net metric ton whenever ferrovanadium is quoted at $3 per pound or less in the United States market. When the price of ferrovanadium is between $3 and $4, for each 10 cents in excess of $3 the duty will be increased 50 cents per ton, and when it is beyond $4 the increase will be $1 for each 10 cents in excess of $4. The Ministry of Finance will fix every quarter the official quotations of vanadium, taking as a basis an average of the selling prices for the first two months of the previous quarter, as forwarded by the Peruvian consul general in New York.

The rates and regulations will be applied to vanadium exportations made from October, 1923, and the differences resulting between the former fixed rate of 45.29 soles and the new duties will be refunded on all exportations from October, 1923.[31]

The production of vanadium ores in 1924, as represented by exports from foreign countries, was as follows:

Production of vanadium in 1924 outside the United States, as indicated by exports

Country	Ore (short tons)	Vanadium content (estimated)	
		Percentage	Short tons
Peru	6,302	11	693.2
British Southwest Africa	1,837	10	183.7
Northern Rhodesia	985	10	98.5
	9,124		975.4

The imports of vanadium ore, 1918 to 1924, are reported by the Bureau of Foreign and Domestic Commerce as follows:

Vanadium ore (steel-hardening) imported for consumption in the United States, 1918–1924

Year	Pounds	Value	Year	Pounds	Value
1918, July to December *	1,772,215	$5,333	1922	611,170	$86,776
1919	6,026,005	67,846	1923	4,177,115	229,210
1920	20,673,296	1,080,935	1924	14,116,596	722,731
1921	10,307,540	543,061			

* Not separately classified prior to July, 1918.

[31] Pearce, W. N., "Reduction of export duty on vanadium": Commerce Reports, Oct. 27, 1924, pp. 247–248.

During 1923 and 1924 no ferrovanadium was imported, though 54,943 pounds, valued at $81,016, were exported.

STATISTICS OF PRODUCTION OF VANADIUM

The following tables of production are taken from the report of the subcommittee on vanadium (W. Spencer Hutchinson (chairman), Harold Boericke, and Frank L. Hess) of the committee on foreign and domestic mining policy of the Mining and Metallurgical Society of America and the committee on industrial preparedness of the American Institute of Mining and Metallurgical Engineers. The titles are self-explanatory.

SCHEDULE 4.—*Origin of vanadium produced in the United States*

Year	Patronite ores from Peru (V in alloy, pounds)	Roscoelite ores from Colorado (V in alloy, pounds)	Carnotite (radium) ores from Colorado (V in alloy, pounds)	Metallic vanadate ores (lead, copper, and zinc) imported (recoverable V, pounds)
1906	None.	None.	None.	750
1907	4,520	None.	None.	2,475
1908	29,737	None.	None.	None.
1909	201,422	3,770	None.	None.
1910	248,847	30,347	None.	None.
1911	242,815	88,102	None.	None.
1912	413,096	210,578	None.	None.
1913	454,993	307,834	None.	None.
1914	324,433	386,773	None.	None.
1915	971,306	440,593	1,147	None.
1916	1,807,964	427,663	109,284	None.
1917	2,009,266	447,107	77,174	None.
1918	1,500,788	258,804	150,497	None.
1919	923,377	109,492	112,751	(a)
1920	1,078,341	229,939	275,929	22,301
1921	116,302	17,703	8,539	20,801
1922	416,315	70,813	150,130	55,499
1923	797,790	24,856	231,004	31,667
Total	11,541,312	3,054,374	1,116,455	133,493

[a] No record.

SCHEDULE 5.—*Summary: Origin of vanadium produced in the United States*

[Eighteen years, 1906-1923]

	Vanadium produced and marketed	
	Pounds	Per cent of total
Patronite ores, Mina Ragra	11,541,312	72.8
Roscoelite ore, Colorado	3,054,374	19.3
Carnotite (radium) ore, Colorado	1,116,455	7.1
Metallic vanadates (lead, copper, zinc), Southwest Africa, etc.	133,493	.8
Total	15,845,634	100.0

SCHEDULE 6.—*Summary: Origin of vanadium consumed in the world, 1920–1923*

	Vanadium produced and marketed	
	Pounds	Per cent of total
Patronite ores	2,408,748	61.0
Roscoelite ores	343,311	8.7
Carnotite ores	665,602	16.9
Metallic vanadates	530,721	13.4
Total	3,948,382	100.0

SCHEDULE 7.—*Foreign production of metallic vanadate ores*

ORE

	Exports from southwest Africa	Union of South Africa	Rhodesia	Other countries	Total
Estimated assay per cent V	10	7.04	10	10	
Recoverable do	7	5.00	7	7	
1919 short tons	None.	None.			
1920 do	310.5	161.40	[a] 40.1	[b] 5.668	517.6
1921 do	426.8	2.10	[c] 153.2		582.1
1922 do	796.3	None.	[c] 211.7	[c] 24.244	1,032.2
1923 do	1,306.3	54.25	[d] 361.2	[e]	1,721.7
1924 do	1,837.0	None.	[f] 985.0		

RECOVERABLE V

1919 pounds	None.	[e]	[e]		None.
1920 do	43,475	16,145	5,614	[b] 762	65,996
1921 do	59,748	210	21,448		81,406
1922 do	111,487	None.	29,638	[c] 3,394	144,519
1923 do	182,886	5,347	50,568		238,801
1924 do	257,180	None.	[d] [f] 137,900		

[a] United States imports, special reports.
[b] From Argentina.
[c] From Peru (ash). (See Mineral Resources, 1922 and 1923.)
[d] By difference, using Mineral Resources reports.
[e] No record.
[f] Northern Rhodesia. There were no shipments in 1924 from southern Rhodesia or from the Union of South Africa.
[g] Probably none.

Vanadium ores are being produced in Southwest Africa at a rapidly increasing rate, and the deposits, although individually small, are relatively numerous and shallow, occurring in "sandsacks"—residual depressions formed by the weathering of dolomite. Exports in 1923 amounted to 1,306 short tons and in 1924 to 1,837 short tons, and considerable improvement is reported in the prospects for a continued expanding production. Taking these facts into account, quantitative expression of ore reserves is arrived at by assigning 10 years' yield at the maximum rate, or 3,500,000 pounds, to probable and an equal quantity to possible vanadium.

SCHEDULE 8.—*Foreign vanadium ores except patronite from Peru*

Year	Total ore	Total recoverable V	Recoverable V taken by United States	Recoverable V taken abroad (by difference)
	Short tons	*Pounds*	*Pounds*	*Pounds*
1920[a]	517.6	65,996	22,301	43,695
1921	582.1	81,406	20,801	60,605
1922	1,032.2	144,519	55,499	89,020
1923	1,721.7	238,801	31,667	207,133
1924	2,822.0	395,080	22,820	372,260

[a] No record for 1919. Probably little or none recovered.

SCHEDULE 9.—*Origin of vanadium consumed in foreign countries, 1919–1924*

Year	Received ferrovanadium from the United States	Recovered from ores from South Africa	Total consumptive demand
	Pounds	*Pounds*	*Pounds*
1919	31,314	(a)	31,314
1920	204,100	43,695	247,795
1921	29,268	60,605	89,873
1922	24,418	89,020	113,438
1923	21,112	207,133	228,245
1924	20,613	372,260	392,873

[a] Little or none.

It is recognized there must be some "slack" at both ends of this record; there were most likely some stocks of ferrovanadium abroad at the beginning of 1919, and there must equally have been stocks of unwrought ore at the end of 1923; but even after taking these facts into account, it is evident that the rest of the world uses a very small quantity of vanadium as compared with the United States.

TESTS FOR RADIUM-URANIUM MINERALS

All minerals that carry uranium also carry radium, a product of the atomic disintegration of uranium. A test for radioactivity is, however, not a conclusive test for radium and uranium, for thorium also has a disintegration product, mesothorium, which closely resembles radium in its behavior. Tests for radioactivity will therefore show only whether the specimen contains radium and uranium or mesothorium and thorium or all four. The appearance of the minerals will generally determine which of the elements is present, but in case of doubt the determination requires more elaborate tests, which should be made by an experienced chemist.

To test for radioactivity lay the mineral to be tested on a plate holder containing a sensitive photographic plate, and if uranium is present in any considerable quantity the plate will be "light struck" within a period ranging from 12 hours to a week, the time depending on the quantity of radioactive matter in the specimen.

When objects are laid directly upon a sensitized film or plate deceptive effects are obtained by pressure. Many supposed "radiographs" made by mere pressure have been received. In some of these the sensitized coating has been entirely removed under the

object and the remainder was so light struck that the experimenter thought he had obtained a "reversed" effect.

TESTS FOR VANADIUM

Most of the vanadium minerals, especially those of the oxidized zone, are readily soluble in mineral acids. Hydrochloric is the most convenient acid to use. If concentrated hydrochloric acid (HCl) is put upon carnotite, uvanite, vanadinite, the descloizites, and some other vanadium minerals it immediately gives a rich red-brown solution. If water is added the color changes to green or disappears. If the dilution is not too great the brown color reappears on the addition of hydrogen peroxide (H_2O_2). If metallic zinc is added the green color will again appear, and may gradually fade until the solution becomes colorless. Calcium vanadate and a few other oxidized minerals do not show the brown-red color at once, but must be treated with the acid for a longer time. Heating will hasten the reaction.

If dilute acid is used the solution is ordinarily greenish, yellowish (from uranium), or nearly colorless. The addition of hydrogen peroxide gives the reddish-brown color, and the addition of zinc will again bring the green color or decolorize the solution. Vanadium-bearing silicates, such as roscoelite, may be treated with dilute acid and either be allowed to stand for some time or be boiled, after which good reactions may be obtained.

With carnotite, vanadinite, the descloizites, and some other minerals it is only necessary to place a drop of concentrated hydrochloric acid upon the mineral to get the rich red-brown color almost instantly. The addition of two or three drops of water makes the color change to light green or disappear.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By V. C. Heikes

PRODUCTION

In 1924 the output of gold, silver, copper, lead, and zinc from Utah mines was valued at $66,227,637, a decrease of $245,274 in comparison with 1923. There were 136 lode producers and 2 placers, against 146 lode producers and 4 placers in 1923. The output of ore and the quantity of all metals except gold and silver increased considerably. Silver decreased 1,883,778 ounces and $4,132,751; the value of gold decreased $48,331; and the value of copper decreased from $32,691,855 to $31,720,100. Lead increased from $14,241,346 to $18,712,870, and zinc from $770,502 to $1,206,541. Published dividends of 11 producers amounted to $9,850,480 in 1924, which makes a total of $251,474,113 paid to stockholders since mining became profitable.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1924

	Number of producers	Ore and tailings	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	138	13,640,618	$3,028,152	17,253,692	242,138,165	233,910,875	18,562,172	$66,227,637
Increase or decrease from 1923	−12	+887,620	−48,331	−1,883,778	+19,744,593	+30,463,082	+7,231,259	−245,274
Total, 1864–1924 [b]	------	----------	110,413,925	470,147,321	3,022,942,078	5,069,153,626	258,027,674	1,292,265,133

[a] Includes small placer production.
[b] The total by years to the end of 1917 appears in U. S. Geol. Survey Prof. Paper 111, p. 127, 1920.

Of the various kinds of ore mined in Utah in 1924 copper ore led in quantity, followed by lead-silver ore and lead-zinc ore. The total value of metals in the ores and tailings was as follows: Dry gold ore, $64,380; dry gold and silver ore, $665,784; dry silver ore, $3,844,644; copper ore, $33,114,565; lead ore, $22,113,979; zinc ore, $1,559; copper-lead ore, $1,298; and lead-zinc ore, $6,421,195. The small placer output was valued at $233.

Ore and metals produced in Utah in 1924

Source	Number of producers	Ore and tailings		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	8	2,129	0.02	2,268.12	1.55	17,584	0.10
Dry gold and silver ore	2	[a] 39,490	.29	11,287.00	7.71	396,867	2.30
Dry silver ore	31	[b] 240,607	1.76	13,543.63	9.25	4,334,693	25.12
Copper ore	18	12,357,366	90.59	83,444.56	56.96	887,541	5.15
Lead ore	105	[c] 729,219	5.35	24,380.08	16.64	9,936,956	57.59
Zinc ore	1	45					
Copper-lead ore	2	[d] 19		1.76		462	
Lead-zinc ore	22	271,743	1.99	11,550.48	7.88	1,679,588	9.74
Total deep mines		13,640,618	100.00	146,475.63	99.99	17,253,691	100.00
Total placer mines	2			11.22	.01	1	
		13,640,618		146,486.85	100.00	17,253,692	100.00

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	40,138	0.02	5,688			
Dry gold and silver ore	1,091,627	.45	294,459	0.13		
Dry silver ore	866,251	.36	6,836,858	2.92		
Copper ore	234,954,343	97.03	199,275	.08		
Lead ore	4,138,013	1.71	179,798,884	76.87	403,789	2.17
Zinc ore					23,984	.13
Copper-lead ore	5,257		3,294			
Lead-zinc ore	1,042,536	.43	46,772,417	20.00	18,134,399	97.70
	[e] 242,138,165	100.00	233,910,875	100.00	18,562,172	100.00

[a] Includes 5,561 tons of tailings.
[b] Includes 16,174 tons of tailings and 72,231 tons of ore leached.
[c] Includes 79,266 tons of tailings and 30 tons of slag.
[d] Includes 8 tons of slag.
[e] Includes 11,668,436 pounds of copper contained in precipitates.

The metals in gold ore were valued at $64,380, an average of $30.24 a ton. The ore averaged 1.065 ounces of gold and 8.26 ounces of silver to the ton and 0.94 per cent of copper and 0.13 per cent of lead. Most of the gold ore was mined in the Tintic district, Juab and Utah Counties.

Dry gold ore sold or treated in Utah in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Box Elder	25	12.58	103		
Garfield	4	3.04	1		
Juab	848	849.06	12,953	28,881	3,672
Piute	122	364.81	398	141	653
Salt Lake	309	186.07	867	10,916	
San Juan	32	27.20	7		
Tooele	62	420.00	206		1,363
Utah	727	405.36	3,049	200	
	2,129	2,268.12	17,584	40,138	5,688

Dry and siliceous silver ore was mined by 31 producers in 1924, against 36 producers in 1923. This ore and tailings averaged $1.16 in gold, 18.02 ounces of silver, 3.60 pounds of copper, and 28.42 pounds of lead to the ton. The Tintic district, in Juab and Utah Counties, had the most silver-ore producers, 17; they reported 157,771 dry tons. One of these producers shipped to a chloridizing-roasting plant at Warm Springs or Harold. The largest producers of silver ore were the Tintic Standard mine at Dividend, the Park-Utah at Park City, the Chief Consolidated mine in the Tintic district, and the Gold Hill

mine of the Western Utah Copper Co., which produced chiefly arsenical ore containing a little silver and lead.

Dry silver ore and tailings sold or treated in Utah in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Box Elder	12	1.00	187	67	178
Juab	[a] 73,176	5,336.27	1,172,949	375,539	2,434,678
Salt Lake	5,252	2,094.89	104,053	9,177	88,981
Summit	[b] 5,082	105.63	69,605	27,284	29,060
Tooele	[c] 27,177	13.79	88,625	2,922	798,593
Utah	[d] 84,640	854.00	1,560,974	304,060	2,465,523
Wasatch	45,268	5,138.05	1,338,300	147,202	1,019,845
	240,607	13,543.63	4,334,693	866,251	6,836,858

[a] Includes 11,045 tons of tailings.
[b] Includes 2,074 tons of tailings.
[c] Includes 3,055 tons of tailings.
[d] Includes 72,231 tons of ore leached.

Copper ore represented 91 per cent of the total ore output of the State. The average content of this ore was 0.007 ounce of gold, 0.07 ounce of silver, and 19.01 pounds of copper to the ton, and the average value in metals was $2.68. Salt Lake County was credited with the largest output, chiefly from the Utah Copper property at Bingham.

Copper ore sold or treated in Utah in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Juab	3,119	165.54	32,181	564,532	30,874
Piute	24	2.61	411	1,950	1,960
Salt Lake	12,353,397	82,790.08	850,097	234,320,976	166,441
Utah	826	486.33	4,852	66,885	
	12,357,366	83,444.56	887,541	234,954,343	199 275

The small quantity of copper-lead ore and slag averaged 0.092 ounce of gold and 24.32 ounces of silver to the ton, and 13.83 per cent of copper and 8.67 per cent of lead; the average value in metals was $68.32 a ton.

The metals in lead ore and tailings were valued at $22,113,979, an average of $30.33 a ton. The output was reported by 105 producers. The ore and tailings averaged 0.033 ounce of gold and 13.63 ounces of silver to the ton, and 0.28 per cent of copper, 12.33 per cent of lead, and 0.03 per cent of zinc. In 1923 there were 99 producers of lead ore, with a value in metals of $21,656,858, or $33.53 a ton.

Lead ore and tailings sold or treated in Utah in 1924, with content in terms of recovered metals

County	Ore and tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	[a] 14,202	671.42	105,420	61,308	2,573,158	
Box Elder	33	2.00	252		12,987	
Iron	23		26	66	11,433	
Juab	115,211	6,961.75	2,669,010	375,626	32,213,782	
Salt Lake	[b] 220,139	8,346.83	1,213,719	1,556,774	46,035,182	
Summit	[c] 222,712	4,407.06	2,947,813	1,107,351	44,426,331	403,789
Tooele	[d] 63,529	391.94	242,705	400,171	5,797,841	
Utah	79,279	2,982.87	2,426,217	344,888	44,507,262	
Wasatch	14,091	616.21	331,794	291,829	4,220,908	
	729,219	24,380.08	9,936,956	4,138,013	179,798,884	403,789

[a] Includes 11,485 tons of tailings.
[b] Includes 30 tons of slag.
[c] Includes 59,500 tons of tailings.
[d] Includes 8,281 tons of tailings.

Nearly all the zinc is to be credited to lead-zinc ore, 54 per cent of which came from Salt Lake County. Most of the ore from that county was concentrated at Midvale, where some custom ore was milled and preparations were under way for more extensive work. In 1924 several lots of lead-zinc ore were shipped to zinc plants in Texas and the Eastern States and some zinc-lead concentrate to a western chemical plant where zinc chloride was made. One small lot of zinc ore was produced in the Tintic district, Juab County.

Lead-zinc ore sold or treated in Utah in 1924, with content in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	85	1.65	251		16,218	40,201
Juab	412	2.75	2,035	511	101,574	138,154
Salt Lake	146,165	9,233.39	750,012	529,795	29,553,835	11,477,212
Summit	45,475	523.70	326,393	171,743	6,407,786	2,131,983
Tooele	117	1.19	453		17,210	22,860
Utah	325	1.26	809	990	86,994	72,957
Wasatch	79,164	1,786.54	599,635	339,497	10,588,800	4,251,032
	271,743	11,550.48	1,679,588	1,042,536	46,772,417	18,134,399

The following table gives the zinc ore, lead-zinc ore, and concentrates produced from 1921 to 1924, also the average zinc content (assay) and the zinc recovered:

Zinc ore, lead-zinc ore, and concentrates (as marketed from Utah mines and mills) sold to smelters, 1921–1924

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
1921		*Short tons*	*Pounds*	*Per cent*	*Pounds*
Concentrates	Salt Lake	97	81,636	42.08	69,390
1922					
Oxidized zinc ore	Box Elder, Juab, and Tooele	1,578	685,501	21.72	479,449
Concentrates	Beaver and Salt Lake	6,103	5,458,776	44.72	4,639,961
		7,681	6,144,277	40.00	5,119,410
1923					
Sulphide lead-zinc ore	Beaver, Juab, Salt Lake, and Utah.	1,360	732,684	26.94	609,020
Oxidized zinc ore	Juab and Utah	48	35,433	36.91	28,346
Oxidized lead-zinc ore	Beaver, Juab, and Tooele	273	177,673	32.54	140,869
Concentrates	Beaver, Salt Lake, Summit, and Wasatch.	15,378	12,865,127	41.83	10,552,678
		17,059	13,810,917	40.48	11,330,913
1924					
Sulphide zinc ore	Juab	45	28,215	31.35	23,984
Sulphide lead-zinc ore	Beaver and Juab	159	90,379	28.42	74,763
Oxidized lead-zinc ore	Juab	36	14,400	20.00	11,520
Concentrates	Beaver, Juab, Salt Lake, Summit, Tooele, Utah, and Wasatch.	23,490	21,184,593	45.09	18,451,905
		23,730	21,317,587	44.92	18,562,172

METALLURGIC INDUSTRY

GENERAL FEATURES

Of the 17 milling plants operated in Utah in 1924, 1 was a chloridizing-roasting and leaching plant, 1 was equipped for amalgamation, and 15 were concentration plants. Eight of the concentration plants used tables followed by oil-flotation devices; in some of these plants flotation has almost replaced tabling. Five mills used ordinary table concentration, and one that was equipped for wet concentration by tables and flotation treated the dried concentrate by electrostatic separation. This method of separation, used only at Midvale, may be replaced entirely by flotation in 1926.

Recovery of gold by amalgamation was again reported from San Juan County, where ore from the Dream mine was treated in a small 5-stamp mill.

The table that follows shows the different kinds of concentrates produced in Utah in 1924. They contained 67 per cent of the gold, 22 per cent of the silver, 92 per cent of the copper, 36 per cent of the lead, and more than 99 per cent of the zinc. The corresponding percentages in 1923 were 67, 17, 95, 29, and 93.

Mine production of gold, silver, copper, lead, and zinc from Utah concentrates in 1924

By counties

County	Ore to concentrating mills	Concentrates	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver	23	17	1.65	120		7,470	7,480	$1,197
Juab	19,320	6,771	400.85	244,426	15,550	3,057,709	84,592	424,205
Salt Lake	12,612,608	752,025	93,227.88	1,809,820	222,297,280	46,652,411	11,477,212	36,738,927
Summit	152,439	41,921	1,993.54	914,343	321,850	20,009,228	2,535,772	2,461,545
Tooele	44,332	10,368	126.20	146,627	368,151	2,688,016	22,860	365,604
Utah	1,021	435	88.01	3,720	12,546	115,074	72,957	19,903
Wasatch	82,070	23,723	1,844.09	605,840	341,911	10,697,533	4,251,032	1,620,944
	12,911,813	835,260	97,682.22	3,724,896	223,357,288	83,227,441	18,451,905	41,632,325

By kinds of concentrates

Copper	641,389	82,283.12	803,148	221,264,006			$31,224,637
Lead	170,381	14,375.06	2,699,840	1,796,239	81,521,754		8,863,099
Zinc	16,253	884.04	140,838	177,043	831,979	13,487,624	1,079,083
Lead-zinc	7,237	140.00	81,070	120,000	873,708	4,964,281	465,506

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Copper	641,389	0.128	1.25	17.25			$48.68
Lead	170,381	.084	15.85	.53	23.92		52.02
Zinc	16,253	.054	8.67	.54	2.56	41.49	66.39
Lead-zinc	7,237	.019	11.20	.83	6.04	34.30	64.32
	835,260	.117	4.46	13.37	4.98	1.10	49.84

Crude ore of all kinds shipped directly to the smelters amounted to 4 per cent of the total output and yielded 32 per cent of the gold, 71 per cent of the silver, 3 per cent of the copper, 62 per cent of the

lead, and 1 per cent of the zinc. The corresponding percentages in 1923 were 31, 76, 3, 69, and 7.

Mine production of gold, silver, copper, lead, and zinc from Utah crude ore shipped to smelters in 1924

By counties

County	Ore	Gold	Silver	Copper	Lead	Zinc	Total value of metal
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver	2,779	132.36	28,918	19,028	819,917	32,721	$92,323
Box Elder	45	3.00	439	67	13,165	----------	1,418
Iron	23	----------	26	66	11,433	----------	941
Juab	196,375	22,714.54	3,967,112	2,304,114	31,511,856	77,546	5,955,343
Piute	146	367.42	809	2,091	2,613	----------	8,620
Salt Lake	112,635	9,413.92	1,108,846	2,465,854	29,189,079	----------	3,595,683
Summit	59,256	2,988.55	2,417,823	971,647	30,853,949	----------	4,277,322
Tooele	35,217	700.72	174,038	34,758	3,828,270	----------	441,906
Utah	92,545	4,629.81	2,948,803	486,936	44,630,426	----------	5,705,627
Wasatch	56,453	5,696.71	1,663,889	436,617	5,132,020	----------	1,700,327
	555,474	46,647.03	12,310,703	6,721,178	145,992,728	110,267	21,779,510

By kinds of ore

Dry and siliceous	188,199	25,502.65	3,608,229	1,650,358	4,214,531	----------	$3,498,059
Copper	11,914	1,161.44	84,393	2,021,901	197,820	----------	361,247
Lead	355,110	19,981.94	8,617,819	3,044,951	141,541,554	----------	17,909,214
Zinc	45	----------	----------	----------	----------	23,984	1,559
Copper-lead	11	1.00	131	3,968	1,607	----------	758
Lead-zinc	195	----------	131	----------	37,216	86,283	8,673

Average recoverable content

	Short tons	*Fine ounces per ton*	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*	
Dry and siliceous	188,199	0.136	19.17	0.44	1.12	----------	$18.59
Copper:							
Oxidized	3,754	.047	13.72	9.03	.59	----------	34.75
Sulphide	8,160	.121	4.03	8.24	.94	----------	28.28
Lead:							
Oxidized	92,272	.063	23.60	.30	17.31	----------	45.60
Sulphide	262,838	.054	24.50	.47	20.85	----------	52.13
Zinc: Oxidized	45	----------	----------	----------	----------	26.65	34.64
Copper-lead: Oxidized	11	.091	11.91	18.04	7.30	----------	68.91
Lead-zinc:							
Oxidized	36	----------	----------	----------	9.72	16.00	36.36
Sulphide	159	----------	.82	----------	9.50	23.51	46.31
	555,474	.084	22.16	.60	13.14	.01	39.21

GOLD

The mine production of gold decreased 1.57 per cent. Most of the gold came from ores mined in Salt Lake, Juab, Wasatch, Summit, and Utah Counties, named in order of output.

In Utah gold is produced largely as a by-product in the smelting of copper and lead ores and concentrates. The Utah Copper property at Bingham was the largest producer of gold in 1924; the Chief Consolidated property, in the Tintic district, was second; and the United States, Park-Utah, Utah Delaware, Utah Apex, Tintic Standard, and Silver King Coalition mines followed.

SILVER

In 1924 Utah was again the largest producer of silver in the United States, but the quantity decreased 10 per cent from 1923. Juab County once more led in output, followed by Utah, Summit, Salt Lake, and Wasatch Counties. In these counties the decrease was especially noticeable in the Tintic and Park City districts. The chloridizing-roasting process was in full operation at only one plant where rich precipitate was produced, from which 1,043,378 ounces of silver were reported for 1924.

Nine properties each produced more than 500,000 ounces of silver in 1924. The Tintic Standard, in the Tintic district, ranked first, with an output of 4,205,463 ounces, followed by the Chief Consolidated mines, with 2,536,417 ounces; the Silver King Coalition (2,551,104 ounces), the Park-Utah (1,764,005 ounces), and the Park City Mining & Smelting Co., in the Park City region; the property of the United States Mining Co., the Utah Copper, and the Utah Apex at Bingham; and the Victoria, in the Tintic district.

COPPER

In 1924 the largest quantity of copper came from ores mined in the Bingham or West Mountain district, Salt Lake County; the Tintic district, Juab County, and the Park City region, Summit and Wasatch Counties, followed.

Crude ore shipped to smelters contained 6,721,178 pounds of copper, against 6,690,876 pounds in 1923; of the copper from crude copper ore smelted 1,344,103 pounds were derived from sulphide ores and 677,798 pounds from oxidized ores; of the lead ores smelted sulphide ores yielded 2,495,098 pounds of copper and oxidized ores 549,853 pounds. The dry and siliceous ore, used chiefly for fluxing at smelting plants, contained 1,650,358 pounds, against 2,393,008 pounds in 1923. The low-grade disseminated ores that were concentrated contained 221,255,726 pounds of copper, against 208,354,907 pounds in 1923.

The leading copper producers were, in order of output, the Utah Copper Co., reporting 214,592,733 net pounds, Ohio Copper, Utah Delaware, Utah Apex, Chief Consolidated, Silver King Coalition, Iron Blossom, and Tintic Standard mines. The Ohio Copper Co. at Lark continued to leach in place the caved area of the mine.

LEAD

The output of lead increased 15 per cent in quantity, largely because of the better price for the metal and the general improvement in market conditions. Nearly every producing lead property was worked at a maximum capacity, as high prices made profitable the mining of considerable ore that had been considered of doubtful commercial value.

The Bingham or West Mountain district produced 69,571,834 pounds, compared with 50,705,666 pounds in 1923. The largest part of the output at Bingham came from the Utah Apex and United States mines. The Park City region produced 66,692,730 pounds, against 52,440,692 pounds in 1923; the Tintic district produced 81,348,458 pounds, against 77,812,795 pounds; the combined production of the Ophir and Rush Valley districts, Tooele County,

decreased from 9,454,661 to 4,680,499 pounds; the output in Beaver County decreased from 3,471,858 to 2,589,376 pounds; and the combined production of the Big and Little Cottonwood districts, Salt Lake County, decreased from 7,662,932 to 6,256,829 pounds.

The Tintic Standard property in the eastern part of the Tintic district was first in lead output and was followed in order by the Silver King Coalition, in the Park City region; the Utah Apex and the property of the United States Mining Co., at Bingham; the Chief Consolidated properties, in the Tintic district; and the Park City Mining & Smelting Co., at Park City. Each of these was credited with producing more than 13,500,000 pounds of lead. Next in rank were the Keystone, Dalton & Lark, Niagara, Victoria, Cardiff, Ophir Hill, and Horn Silver mines.

ZINC

The mine production of zinc increased 64 per cent, due to better recovery. The mines of the United States Mining Co. at Bingham produced more than three times as much as any other property. The Park City Mining & Smelting Co. was second and the Park-Utah mine third; both are in the Park City region. Zinc concentrate from several properties and from the mill at International, Utah, was shipped to Great Falls, Mont.

MINING AND METALLURGIC INDUSTRY

In the Salt Lake and Tooele Valleys all smelting plants handled more ore than formerly. All lead-silver-zinc and lead-silver producers, particularly in the Tintic, Park City, and West Mountain districts, prospered by the high price of lead, which offset the lower silver prices that resulted from the termination of the Pittman Act in 1923. Lead smelters in Utah operated six furnaces each at Murray and Midvale and two at International were in blast. The copper smelter at Garfield treated copper-iron concentrate of the Utah Copper Co. chiefly and ran continuously.

Wages in many camps went up in May, when the mining companies at Bingham, including the Utah Copper Co., gave an advance of 25 cents a day. Freight rates on bullion from the smelters to eastern refineries were lowered 18 to 24 per cent.

At Tooele the International Smelting Co. remodeled its concentrator, which had been used for Highland Boy copper ore exclusively, into a flotation plant of 1,000 tons daily capacity for differential flotation of zinc-lead ores from custom shippers. This innovation, connected with smelter purchases of ore, affords a market for certain classes of ore that could not be shipped heretofore. The saving announced on such ores by the International Co. was 70 to 85 per cent of the lead and zinc. A lead concentrate assaying from 55 to 60 per cent lead and 7 to 9 per cent zinc was made; it was reduced at the furnaces with another product of the mill, an iron concentrate, that contained 40 per cent of iron, 10 ounces of silver, and $4 to $5 a ton in gold. The zinc concentrate, assaying 50 to 55 per cent zinc, was reduced at the zinc plant of the Anaconda Copper Mining Co. at Great Falls, Mont. At Midvale the United States Smelting,

Refining & Mining Co. planned to start construction in 1925 of a differential flotation plant to treat its Bingham ore and custom lead-silver-zinc ores.

The Chief Consolidated Co. at Eureka installed a process to handle lead-silver ores carrying both oxides and sulphides. The ore, crushed to 80-mesh size by breaker, rolls, and ball mill, passes to a flotation plant where most of the sulphides are removed; the remaining sulphides are removed by table concentration. In 1924 tests continued at the volatilization plant designed for recovery of the remaining oxides of lead and the gold and silver. The ore is heated to 1,650° C. in a 10 by 80 foot kiln, from which the gases pass through flues to a bag house.

The Utah Apex mill at Bingham, which formerly used jigs, tables, and flotation in the treatment of lead-silver ore, now crushes to flotation size in three stages—jawbreaker, rolls, and Marcy ball mill. Callow cells are used as primary roughers, making a finished concentrate, and the tailing goes to secondary roughers. The tables make a finished concentrate, a middling which is returned to the table, and a tailing which goes to waste. From a feed assaying 7.75 per cent of lead and 2.37 ounces of silver to the ton the recovery is 94.4 per cent of the lead and 90.6 per cent of the silver.

The Honorine mill at Bauer, near Tooele, was reconstructed and a large hydrometallurgical plant started late in 1924. The Combined Metals Co., financed by the National Lead Co., built a plant to treat lead-zinc ores mined in Nevada and Utah. The first tests of the process used were at a plant operated for many months at Florence, Colo., by the National Lead Co. in cooperation with Edward H. Snyder and N. C. Christensen. The plan was to float a high-grade zinc concentrate from the Pioche ore, leaving a product containing about 18 per cent of lead and 5 per cent of zinc for treatment in a lead-leaching plant. The features of the leaching plant are the agitation of the unroasted ore in a hot brine solution containing a small quantity of hydrochloric acid, filtration and washing with hot weak solution and water, precipitation of the lead by cooling the pregnant solution, and reduction of the lead by melting with a mixture of lime and coal dust.[1] The ore shipped from the Combined Metals property at Pioche, Nev., is low in lime; it averages about 8 ounces of silver to the ton, and 8 per cent of lead, 18 per cent of zinc, 26 per cent of silica, and 14 per cent of iron.

The remaining remodeled units of the Utah Copper mills at Magna and Arthur were completed, giving the mills a combined capacity of 40,000 tons of ore a day. In 1924 they treated 6,522,800 and 5,603,800 tons of ore, respectively, equivalent to a daily average of 33,406 tons. In the third quarter of 1924 an extraction of 87.24 per cent of the copper was obtained from a feed assaying only 1.06 per cent of copper. Before they were remodeled the mills obtained an extraction of only 65 per cent.

At the Ohio Copper property leaching ore in place was continued in 1924. Detinned scrap was the copper precipitant, and the product averaged 90 per cent of copper. The output of copper in 1924 was 11,115,329 pounds; the operating cost was slightly more than 5¾ cents a pound.

[1] The hydrometallurgical process at Bauer, Utah, is fully described in the Eng. and Min. Jour.-Press, vol. 119, Jan. 10, 1925, pp. 60–61.

REVIEW BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1924

County	Gold					Silver •	
	Placers		Deep mines		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Beaver			673.09	$13,914	$13,914	105,671	$70,799
Box Elder			15.57	322	322	542	363
Garfield	6.14	$127	3.05	63	190	1	1
Iron						26	17
Juab			24,602.36	508,576	508,576	4,285,995	2,871,617
Piute			367.41	7,595	7,595	809	542
Salt Lake			102,653.01	2,122,026	2,122,026	2,919,210	1,955,871
San Juan			27.19	562	562	7	5
Summit			5,036.42	104,112	104,112	3,343,811	2,240,353
Tooele			826.92	17,094	17,094	331,989	222,433
Utah			4,729.82	97,774	97,774	3,995,901	2,677,254
Wasatch			7,540.79	155,882	155,882	2,269,729	1,520,718
Wayne	5.08	105			105	1	1
Total, 1923	11.22	232	146,475.63	3,027,920	3,028,152	17,253,692	11,559,974
	25.49	527	148,799.37	3,075,956	3,076,483	19,137,470	15,692,725

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	61,308	$8,032	2,589,376	$207,150	40,201	$2,613	$302,508
Box Elder	67	9	13,165	1,053			1,747
Garfield							191
Iron	66	9	11,433	915			941
Juab	2,436,716	319,210	35,079,039	2,806,323	162,138	10,539	6,516,265
Piute	2,091	274	2,613	209			8,620
Salt Lake	236,432,895	30,972,709	75,847,733	6,067,819	11,477,212	746,019	41,864,444
San Juan							567
Summit	1,306,378	171,136	50,863,177	4,069,054	2,535,772	164,825	6,749,480
Tooele	403,093	52,804	6,615,007	529,201	22,860	1,486	823,018
Utah	717,023	93,930	47,059,779	3,764,782	72,957	4,742	6,638,482
Wasatch	778,528	101,987	15,829,553	1,266,364	4,251,032	276,317	3,321,268
Wayne							106
	242,138,165	31,720,100	233,910,875	18,712,870	18,562,172	1,206,541	66,227,637
Total, 1923	222,393,572	32,691,855	203,447,793	14,241,346	11,330,913	770,502	66,472,911

• Includes very small placer production.

Ore sold or treated, number of deep mines producing, and value of ores in Utah, 1923–24, by counties

County	Ore and tailings sold or treated, 1924 (short tons)		Number of deep mines producing		Average total value per ton •		Average value per ton in gold and silver •	
	Total	Increase or decrease	1923	1924	1923	1924	1923	1924
Beaver	14,287	−2,988	14	8	$22.67	$21.17	$7.20	$5.93
Box Elder	70	−31,791	4	3	21.80	24.96	21.26	9.79
Garfield	4	+4		1		16.00		16.00
Iron	23	−7	1	1	33.80	40.91	.90	.74
Juab	232,301	−19,340	31	26	33.98	28.05	20.77	14.55
Piute	146	−16,763	4	2	19.03	59.04	15.57	55.73
Salt Lake	12,725,281	+874,954	42	36	3.39	3.29	.34	.32
San Juan	32	+22	1	1	14.10	17.72	14.10	17.72
Sevier		−15	2		24.67		24.33	
Summit	273,269	+24,150	10	8	21.00	24.70	9.49	8.58
Tooele	90,885	+12,864	23	29	16.16	9.06	5.33	2.64
Utah	165,797	+12,246	11	16	36.34	40.04	19.08	16.74
Wasatch	138,523	+34,320	2	5	41.05	23.98	26.09	12.10
Washington		−36	1		55.39		15.14	
	13,640,618	+887,620	146	136	5.21	4.85	1.47	1.07

• Value per ton, placer product excluded.

BEAVER COUNTY

All the metals in ore mined in Beaver County decreased in quantity and value in 1924. There were eight producers, six less than in 1923. The output of ore and tailings decreased from 17,275 to 14,287 tons, gold from $14,914 to $13,914, silver from 133,428 to 105,671 fine ounces, copper from 92,850 to 61,308 pounds, lead from 3,471,858 to 2,589,376 pounds, zinc from 156,372 to 40,201 pounds, and the total value from $391,637 to $302,508.

Lincoln district.—The Croff company shipped sulphide lead ore containing gold and silver to the smelter. One lot of ore went to a custom milling plant, where lead concentrate and zinc concentrate were produced. The ore shipped to the smelter contained about $3 in gold and 10 to 20 ounces of silver to the ton; the lead content averaged about 28 per cent and the zinc about 3 per cent.

San Francisco district (Frisco, Newhouse).—The only producing mine in the San Francisco district was the Horn Silver, largely worked by lessees. Lead ore was shipped directly to the smelters and crude ore containing lead and zinc to a custom concentrator. Considerable tailing was shipped from the mill dump.

Star and North Star district.—All the ore mined by six operators in the Star district, amounting to 1,060 tons, was shipped to smelters and contained $498 in gold, 9,075 ounces of silver, 9,677 pounds of copper, and 335,423 pounds of lead, valued in all at $34,680, or $32.72 a ton. Most of the ore came from the Moscow mine; it averaged about 40 cents in gold and 10 ounces of silver to the ton, and 17 per cent of lead, 1 per cent of copper, 30 per cent of sulphur, 15 per cent of zinc, and 22 per cent of iron. From the Harrington-Hickory mine, of the Majestic Mines Co., several lots of ore averaging 10 ounces of silver to the ton and 14 per cent of lead were shipped directly to the smelter. A lessee on the Wild Bill property shipped lead-silver ore containing 4 ounces of silver to the ton and 12 to 23 per cent of lead. The St. Croix company produced oxidized lead ore which was loaded at Laho, a siding on the Union Pacific Railroad, and shipped directly to the smelter.

BOX ELDER COUNTY

Mining was carried on in a small way in the Lucin, Ashbrook, and Park Valley districts, but the reported production of ore was not important.

GARFIELD COUNTY

The Red Canyon placer, in the White Canyon district, yielded a little bullion having a fineness of 0.923 in gold. In the Imperial district the Bromide Gold Mines Co. made a small clean-up of gold bullion which was shipped to the mint.

IRON COUNTY

Calumet district.—From the property of the Coin Silver Mines Co. one lot of oxidized lead ore averaging about 25 per cent of lead and 1 ounce of silver to the ton was shipped to the smelter.

JUAB COUNTY

Fish Springs district.—Lessees shipped lead ore from the Utah and Galena mines to smelters near Salt Lake City.

Mount Nebo district.—Owners of the Starlight and Eva properties shipped lead ore from Starr and Mono on the Union Pacific Railroad.

Spring Creek district.—The Premier Silver property, 30 miles southwest of Gold Hill, was active throughout the year. Oxidized lead ore containing silver was shipped in the course of development work. An inclined shaft is down 110 feet.

Tintic district.—Part of the Tintic district lies in Utah County, and a number of important mines in the eastern part of the district are included in this review and in the tables for the district.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, in 1924

County	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab	17	230,948	$504,676	4,274,164	2,435,988	34,678,799	157,259	$6,472,006
Utah	8	163,796	86,729	3,980,353	640,353	46,669,659		6,571,025
	25	394,744	591,405	8,254,517	3,076,341	81,348,458	157,259	13,043,031
Increase or decrease from 1923	−6	−7,226	+60,061	−977,443	+43,785	+3,535,663	−161,632	−972,885
Total, 1869–1924			36,350,956	179,215,528	194,290,862	1,091,173,158	17,843,160	262,369,026

Total dividends, 1869–1924, $40,219,306.

The values of the metals for 1924 are as follows: Gold, $591,405, against $531,344 in 1923; silver, $5,530,526, against $7,570,207; copper, $403,001, against $445,786; lead, $6,507,877, against $5,446,895; zinc, $10,222, against $21,684. The ore sold or treated in the district in 1924 averaged $33.04 a ton in metals, compared with $34.87 in 1923.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, in 1924, by kinds of ore

Kind of ore	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	17	198,836	18,731.67	3,146,099	1,799,647	5,197,507	
Copper	2	3,119	165.54	32,181	564,532	30,874	
Lead	19	192,353	9,709.42	5,074,249	711,651	76,024,663	
Zinc	1	45					23,984
Lead-zinc	2	391	2.59	1,988	511	95,414	133,275
		394,744	28,609.22	8,254,517	3,076,341	81,348,458	157,259

The Chief Consolidated Co., the second largest producer of silver in the State, contributed 120,707 dry tons of ore, which yielded $357,556.67 after transportation, sampling, and all operating charges were deducted. Dividends amounting to $2,869,380.87 have been

paid to stockholders since February, 1913, including $199,275.80 paid in 1924. The combined output of all properties is given as follows in the company's annual report:

Ore and metals produced by Chief Consolidated Co. in 1924 and 1909–1924

Year	Ore	Gold	Silver	Lead	Copper	Zinc	Net returns	
							From smelter	After charges
	Dry tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*		
1924	120,707	14,194	2,536,417	21,831,084	893,963	49,462	$2,099,869	$357,556
1909–1924 [a]	1,018,053	98,151	29,253,391	156,146,662	3,318,145	2,818,699	[b] 22,376,686	[b] 5,518,017

[a] The production of the Chief Consolidated mine by years is given in Mineral Resources, 1918, pt. 1, p. 388.
[b] Includes returns on 360,716 pounds of manganese in 1918.

These totals do not include dump ore amounting to 27,099 tons, shipped for converter lining. All the ore produced in 1924 came from four mines of the company—the Chief mine No. 1 shaft and No. 2 shaft, Gemini and Ridge & Valley mine No. 3 shaft, Eureka Hill No. 4 shaft, and Grand Central mine No. 5 shaft. These mines produced 61,870 tons of silver-lead ore, 39,762 tons of dry and siliceous ore containing a little copper, 14,539 tons of silver-lead and 4,439 tons of dry and siliceous ore shipped to the concentrating plant, and 97 tons of zinc-lead ore shipped to a zinc oxide plant in Oklahoma. Paragraphs from the company's annual report follow:

Ore is being delivered through No. 1 shaft from almost every level, and the response of the old 1,200, 1,400, and 1,600 foot levels to new development work has been most gratifying. Mine operations in No. 1 mine are now being carried on to a point some distance below the 2,300-foot level without any considerable difficulties having been encountered from water or other causes, and present indications are that larger and more profitable ore bodies are to be expected with added depth.

The operation of the new mill during the last half of the year opened a new era for this mine in its highly siliceous sulphide ore bodies beneath permanent water level. Its assistance has materially aided the finding of better grades of ore.

A big advance has been made during the past year in the development of the large siliceous ore body at No. 5 shaft on its lower levels. At no point, however, can it be stated that its boundary has actually been determined. The lowest workings therein (the 2,300-foot level) indicate that much is to be expected, both as to size and increased value, at still greater depths, and provision is now being made for development on lower levels. Prospecting is being carried on and ore is being extracted from nearly every level of this mine. A newly found channel west of the previously developed part of the zone on the upper levels promises much, having already yielded considerable ore of good value.

Operations at shafts No. 3 and 4 were suspended about midyear. * * *

The past year's activities in the Plutus mine have been notable in that this property passed out of the prospect stage during this year. No. 1 fissure has been proven to carry ore of more than ordinary value, and No. 2 fissure was found and has from the date of its discovery been a steady and satisfactory producer. During 1924 the Plutus lessees have worked from 100 feet above to 160 feet below the 1,300-foot level of the No. 5 mine, and the 1,100 and 1,600 foot levels of that mine are being projected to cut the two fissures at their respective elevations.

The sinking of the Apex Standard No. 2 shaft was completed to a connection with the 900-foot level of that mine. * * * One set of lessees shipped one carload of ore from a fissure (in quartzite) exposed by a raise some distance over the 900-foot level, and they have developed this fissure to such an extent that several more shipments are in sight. * * * Prospecting on this fissure will be continued.

From the Eagle & Blue Bell mine [2] 11,449 dry tons of ore were shipped in 1924, compared with 19,492 tons in 1923. Of the output in 1924, 4,232 tons were mixed carbonate and sulphide lead ore, 1,907 tons dry and siliceous ore, 2,553 tons dump ore, and 2,757 tons were shipped by lessees. The lead ore contained 211.02 ounces of gold, 63,419 ounces of silver, 633,275 pounds of lead, and 4,378 pounds of copper. The dry ore contained 158.36 ounces of gold, 28,872 ounces of silver, 7,978 pounds of lead, and 5,444 pounds of copper. The dump ore contained 170.06 ounces of gold, 23,039 ounces of silver, 1,308 pounds of lead, and 5,691 pounds of copper. After charges for these three classes of ore for freight, smelting, and sampling were deducted the net smelter returns amounted to $59,570.54. No dividends were distributed to stockholders in 1924. The company's report says:

Mining was continued on the ore body discovered in 1923 on the 1,550 level in the north end of the property until the ore became too low-grade. A crosscut was then made toward the west and disclosed small bunches of lead-silver. Low-grade lead-silver ore was also developed almost directly beneath the 1,550 developments by a 140-foot raise above the 2,000 north drift. By careful selection a shipping product is obtained.

The practicability of "long-hole" drilling—that is, the drilling of holes from mine openings for distances up to 200 feet with special equipment—has been demonstrated in the Tintic district, so early in the year the Eagle & Blue Bell adopted this new method of prospecting. This method seems especially adapted to conditions prevailing in the Eagle & Blue Bell mine, with its extensive openings in the mineralized area and the irregularity of the ore bodies in the limestone. A total of 3,042 feet of "long-hole" drilling was done during the year at a cost of 64 cents per foot, as a result of which two ore bodies were disclosed, the 129 and the 1,782, both on the 1,700-foot level.

The American Star mine,[3] controlled by the Bingham Mines Co., was a regular shipper during 1924, yielding a total of 7,612 dry tons of ore (2,119 tons of dry and siliceous ore, 5,446 tons of ore from the dump, and 47 tons of lead ore). The dry ore contained 234 ounces of gold, 70,677 ounces of silver, and 16,668 pounds of copper, valued in all at $48,960, for which the net smelter return was $34,979. The dump ore contained 422.33 ounces of gold, 54,740 ounces of silver, and 22,636 pounds of copper, valued in all at $39,170 gross or $10,563 net. The lead ore contained 2.91 ounces of gold, 1,893 ounces of silver, 13,623 pounds of lead, and 282 pounds of copper, valued in all at $2,299 gross or $1,832 net. The company's report says:

Operations were confined to the development, on the 1,650 and 1,700 sublevels, of the ore channel found in 1922, which strikes north-south across the property, and showed a continuity of the low-grade quartz deposit. This deposit also contains occasional bunches of high-grade ore, which is mined separately from the low-grade. A strong showing of high-grade is being followed below the 1,700 sublevel, and a number of the low-grade faces on the 1,650 are being advanced.

The Victoria mine [3] produced 10,918 dry tons of ore, of which 9,213 tons were lead ore, containing 857.52 ounces of gold, 424,235 ounces of silver, 3,070,154 pounds of lead, and 78,841 pounds of copper, valued in all at $482,368, for which the net smelter return was $385,501. The dry and siliceous ore amounted to 1,517 dry tons, containing 156.49 ounces of gold, 31,537 ounces of silver, 15,786

[2] Eagle & Blue Bell Mining Co. Ann. Report for 1924.
[3] Bingham Mines Co. Sixteenth Ann. Rept., for year ended Dec. 31, 1924.

pounds of lead, and 5,557 pounds of copper, valued in all at $23,234 gross or $14,120 net. Shipments of dump ore amounted to 188 tons, containing 18.01 ounces of gold, 1,883 ounces of silver, 1,037 pounds of lead, and 1,057 pounds of copper, valued in all at $1,475 gross or $485 net. The company's report says:

> Near the south end of the property, 1,300 level, two high-grade lead-silver ore bodies were disclosed, which have already been exploited for distances of 300 feet each along a general north-south course. * * *
>
> To develop these ore bodies at greater depth, the Eagle 1,350 level is being advanced, 235 feet below, and the indications are very promising.
>
> In early days some very promising quartz showings were disclosed in the Bingham Mines Co.'s Snow Flake property, northwest of the Victoria, from which it is separated by the Eagle & Blue Bell. The property was then developed from surface down to the 700 level. So favorable are the indications that the company is now extending the Eagle 1,700 level northwesterly into the Snow Flake, with the hope of finding profitable ore bodies below the old workings.

Ore sales from the Iron Blossom mine [4] amounted to $340,907 and dividends paid $50,000. Extensive development work was done by lessees who opened several small deposits of ore in the Blue Bell formation south of the Sioux-Ajax fault. Shaft No. 1 was used and work was done at the 200, 400, 500, 600, 700, 800, and 1,100 foot levels. The 1,100-foot level produced about 600 tons of copper ore. The largest part of the ore, however, came from the East vein, which lies 110 feet east of the old ore channel. The cost of drifting was $6.85 a foot, crosscutting $7.20, raises $4.90, and winzes $9.85.

From the Tintic Standard mine [5] were produced 156,397 dry tons of ore, containing 6,147.41 ounces of gold, 4,205,463 ounces of silver, 53,464,075 pounds of lead, and 1,149,283 pounds of copper, which together sold for $6,721,575. After smelter, freight, and treatment charges of $1,969,458 were deducted the net smelter returns amounted to $4,752,117. The mining cost amounted to $751,876, milling $666,668, taxes in State and county $163,330; the total operating cost was $1,581,874, and the operating income was $3,170,243. Deduction of general administrative expense, $71,450, and depreciation, plant and equipment, $138,783, from the operating income left a net operating income, before allowance for depletion and Federal taxes, of $2,960,010, which was increased to $3,087,668 by $127,658 nonoperating income. Deduction of $522,537 for depletion and $312,798 for Federal income taxes left $2,252,333 net income. On December 31 the total assets of the company were $3,181,538. Dividends of $1,320,620 declared in 1924 bring the total disbursements of the company to $3,673,225. In December another car of 52 tons of ore averaged more than 60 ounces of silver and $7 in gold to the ton and 5 per cent of lead, on which the net smelter returns were about $22,000.

Lead ore of shipping grade was found in the Apex Standard mine about 90 feet above the 950-foot level.

In the Iron King property 2 feet of silver-lead ore was opened on the 1,565-foot level. A new electric hoist was added to the shaft equipment. Drifting was started on the 1,300-foot level to find the extension of the ore cut at a lower level. About 700 tons of lead ore were shipped in 1924.

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[4] Iron Blossom Consolidated Mining Co. Ann. Rept. for year ended Dec. 31, 1924.
[5] Tintic Standard Mining Co. Ann. Rept for 1924.

The Centennial Eureka and Bullion Beck & Champion mines were shut down at the end of the year, as the royalties from leasing were too small to warrant operation.

Dump ore was shipped from the Hamburg workings of the May Day property. This property, the Uncle Sam, and the Yankee property were consolidated for future operation by the Mountain View Mining Co. The Godiva property, worked by the Bechtol Leasing Co., produced about 500 tons of lead ore. At the Tintic Drain tunnel lessees shipped about 450 tons of lead ore from the Treasure Hill property. The Dragon Consolidated shipped its usual output of iron flux to the smelters and about 200 tons of oxidized copper ore. The Little May mine, in the southern part of the district, deepened its shaft to 220 feet and opened a level at that point. Some lead ore, which assayed 39 per cent of lead, 16 ounces of silver, and $1 in gold to the ton, was found.

The Silver City plant of the Tintic Milling Co. did not operate in 1924, but considerable tailing from the plant was shipped to the smelter. The dump contains about 400,000 tons of highly siliceous tailing which contains no lime. Preparations were made to lay a spur track to the dump and load the tailing on cars by steam shovel. The tailing dump of the old Mammoth mill was sold to the smelter and partly moved. Several other mine dumps which had been considered waste were purchased and some shipments were made to smelters.

West Tintic district.—Lead-silver ore containing a little gold was shipped from Jericho, on the Union Pacific Railroad, from the mine dump of the Scotia property. This property has a vertical shaft 150 feet deep and an inclined shaft 295 feet deep. Some development work was done in 1924. There was considerable activity at the Imperial Lead property, near Lucerne, on the Union Pacific Railroad. A milling plant has been erected near the property, and preparations have been made for an important production in 1925. The shipments of ore in 1924 were sent to milling plants to test the separation of lead and zinc concentrates.

PIUTE COUNTY

Mount Baldy district.—At the Deer Trail about 2,500 feet of development work was done and some gold-silver ore mined in the course of development was shipped. The mill was closed the entire year.

Ohio district.—One lot of lead-copper ore containing a little silver was shipped from a property worked by the Tushar Range Metals Mining Co.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Five producers in the Big Cottonwood district reported the output of 7,082 tons of ore, which contained $933 in gold, 212,011 ounces of silver, 21,927 pounds of copper, and 3,273,700 pounds of lead, valued in all at $407,748, or $57.58 a ton. The Cardiff mine produced most of the lead ore and the company shipped 40 to 50 tons of lead ore a day most of the year, or a total of about 7,000 tons. Stockholders received $100,000 in dividends. Small lots of lead ore carrying silver were shipped

from the Howell, Cottonwood King, Prince of Wales, and Alta Tunnel properties.

In the Little Cottonwood district six producers reported 9,546 tons of ore, which contained $4,125 in gold, 211,165 ounces of silver, 224,373 pounds of copper, and 2,983,129 pounds of lead, valued in all at $413,649, or $43.33 a ton.

The chief producers of ore in the Little Cottonwood district were the Columbus Rexall, Michigan-Utah, Alta Merger, and West Toledo mines.

Mine production of gold, silver, copper, and lead in Big Cottonwood and Little Cottonwood mining districts, Utah, in 1924

Year	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	11	16,628	$5,058	423,176	246,300	6,256,829	----------	$821,397
Increase or decrease from 1923	−3	−2,046	+784	+58,821	−98,253	−1,406,103	----------	68,703−
Total, 1867–1924	-------	571,893	547,450	15,750,486	14,697,082	220,867,780	322,055	31,836,337

The Columbus-Rexall mine, on the Alta side of the district, is reported to have opened new ore 180 feet below the tunnel level. This ore is said to be 5 to 10 feet wide for about 100 feet along its strike and to assay 30 ounces of silver to the ton and 10 per cent of copper. Shipments of about 4,000 tons of lead-copper ore containing silver from the tunnel level represented the 1924 output. Lead carbonate ore mined from the upper workings 600 feet above the Columbus-Rexall tunnel was shipped. The Alta Merger mines,[6] formerly the South Hecla, Sells, etc., produced 2,029 tons of ore which contained 104.60 ounces of gold, 47,281 ounces of silver, 357,286 pounds of lead, 44,460 pounds of copper, 18,956 pounds of bismuth, and 444,538 pounds of iron, valued in all at $61,510. The smelting, freight, and selling charges amounted to $17,078, leaving net smelter returns of $44,432. All the ore came from the "Gold Ore Zone" stope and was mined from above the Dwyer tunnel level.

The Emma Silver mine[7] produced 802 tons of direct smelting ore which contained 12.22 ounces of gold, 12,876 ounces of silver, 4,511 pounds of copper, 17,671 pounds of lead, and 167,267 pounds of iron, valued in all at $17,740. Smelting, freight, and selling charges amounted to $6,815, leaving net smelter returns of $10,925. The Cabin mine was operated by the Emma Co. through the workings of the Tom Moore tunnel.

Bingham or West Mountain district.—In 1924 the mines of the Bingham district produced ore averaging $3.23 a ton, against $3.32 a ton in 1923. Shipments of ore to the smelters amounted to 95,952 tons, against 96,039 tons in 1923; the output of concentrating ore was 12,612,608 tons, against 11,733,680 tons; and the quantity of concentrates produced was 752,025 tons, against 678,919 tons. Ore of smelting grade amounting to 95,952 tons consisted of low-grade

[6] Alta Merger Mines Co. Ann. Rept. for year ended Dec. 31, 1924.
[7] Emma Silver Mines Co. Ann. Rept. for year ended Dec. 31, 1924.

copper and lead sulphides and contained 9,164.71 ounces of gold, 684,878 ounces of silver, 2,214,906 pounds of copper, and 22,917,968 pounds of lead, valued in all at $2,771,909, or $28.89 a ton. Milling ores, of which there were 12,612,608 tons, yielded 752,025 tons of copper, lead, zinc, and lead-zinc concentrates that contained 93,227.88 ounces of gold, 1,809,820 ounces of silver, 222,297,280 pounds of copper, 46,652,411 pounds of lead, and 11,477,212 pounds of zinc, valued in all at $36,738,927, or $48.85 a ton of concentrates. In addition, copper precipitate containing 11,668,436 pounds of copper was shipped.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Utah, in 1924

	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	21	12,708,560	$2,116,643	2,494,698	236,180,622	69,571,834	11,477,212	$41,039,519
Increase or decrease from 1923	−3	+878,721	+52,502	+448,627	+20,143,476	+18,866,168	+8,392,917	+1,781,011
Total, 1865–1924	-------	----------	[a]42,141,623	[a]60,946,738	2,669,188,819	1,428,515,211	69,736,468	642,341,678

[a] Includes small placer production.

Total dividends, 1865–1924, $143,298,194.

Ore and metals produced in Bingham district, Utah, in 1924, by kinds of ore

Kind of ore	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous ore	3	5,561	2,280.97	104,920	20,093	88,981	----------
Copper ore	12	12,352,762	82,779.08	830,787	234,207,710	153,322	----------
Lead ore	15	204,072	8,099.16	808,979	1,423,024	39,775,696	----------
Lead-zinc ore	6	146,165	9,233.39	750,012	529,795	29,553,835	11,477,212
	-------	12,708,560	102,392.60	2,494,698	236,180,622	69,571,834	11,477,212

The Utah Copper Co.[8] shipped from its property at Bingham to its Magna and Arthur mills 12,126,600 tons of concentrating ore, mostly mined by steam shovel from the upper levels where the grade is lower than the average. In addition, 474 tons of crude ore mined by lessees were shipped to the smelter, and 293,960 pounds of copper were recovered from mine water that passed through the precipitating plants at the mine. During 1924 the Magna plant treated 6,522,800 tons of ore and the Arthur plant 5,603,800 tons, equivalent to a daily average of 33,406 tons. The average grade of the ore treated was 1.07 per cent of copper, compared with 1.12 per cent in 1923. The average recovery was 85.94 per cent, corresponding to 18.43 pounds of copper per ton of ore treated, as compared with 80.96 per cent recovery, or 18.18 pounds of copper per ton of ore treated, in 1923. The total gross copper in the concentrate produced was 223,524,127 pounds, and the concentrate averaged 18.07

[8] Utah Copper Co. Twentieth Ann. Rept., for year ended Dec. 31, 1924.

per cent of copper as compared with 202,986,306 pounds and 18.63 per cent for 1923. The average milling cost of treating the ore was 60 cents a ton, mining 36 cents, and transportation 13 cents, a total of $1.09 a ton.

The average cost per net pound of copper, including the depreciation of plant and equipment and all fixed and general expenses and the credit to gold, silver, and miscellaneous earnings, was 8.89 cents, as compared with 8.74 cents for 1923 computed on the same basis. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.206 cents a pound of copper, compared with 1.313 cents in 1923.

Including the small quantity of copper recovered by precipitation from mine water, a total of 214,592,733 pounds of refined copper were sold, the average price was 13.121 cents a pound, making a total of $28,156,890.58. The gold output amounted to 76,907.10 ounces, valued at $20 an ounce, or a total of $1,538,142.04. Silver amounted to 652,586 ounces, which sold for an average of 66.75 cents an ounce, or a total of $435,618.77. Altogether the metals brought $30,130,-651.39; the operating expenses were $20,478,945.96, leaving a profit of $9,651,705.43, to which was added a miscellaneous income of $614,053.05, or a total of $10,265,758.48. After $2,080,438.97 charged to the income account was deducted, $8,185,319.51 was the net income, which, added to the surplus from operations as of December 31, 1923, gives a total of $48,657,266.55. From this surplus dividends amounted to $248,553.19 and distribution of capital $6,249,406.81, a total of $6,497,960, representing $4 a share for the year. The total disbursement to stockholders to December 31, 1924, was $131,815,787.50.

In the Dalton and Lark mines [9] exploration disclosed new silver-lead-zinc ore bodies in the Lark and Brooklyn veins; one of the most important is in the Lark vein and has been developed for 250 feet by a raise above the main tunnel. Due to the lower grade of the copper ore and the price of copper, shipments of copper ore were suspended. This class of ore formerly constituted the larger part of the output. Lead ore, amounting to 14,634 tons and purchased for $148,678.57 by the smelters, was mined from the Lark vein in the workings known as winze 4 west and winze 2 east, the Mascotte east drift, the 1,100-foot level of the Revere claim, and the Lead mine. In addition to this ore, the Lead mine produced 5,119 tons of dry and siliceous ore, for which the smelter paid $74,231.40. The company's output was as follows:

Mine production of gold, silver, lead, and copper by Dalton & Lark mines, Bingham district, Utah, in 1924

Kind of ore	Ore	Gold	Silver	Lead	Copper	Gross value	Smelter returns
	Dry tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*		
Lead ore	14,634	302.34	111,781.07	3,307,482	220,952	$277,818.93	$148,678.57
Dry ore	5,119	2,092.38	101,885.63	----------	5,710	104,414.30	74,231.40
	[a] 19,753	2,394.72	213,666.70	3,307,482	226,662	382,233.23	222,909.97
Company and lease ore produced, 1909–1924	----------	27,404	3,184,607	48,847,541	10,012,708	----------	----------

[a] Exclusive of 3,378.99 dry tons of ore mined by lessees, on which the company received $17,345 as royalty.

[9] Bingham Mines Co. Sixteenth Ann. Rept., for year ended Dec. 31, 1924.

At the Ohio Copper property [10] leaching in place was continued in 1924, and 11,115,329 pounds of copper were produced at an operating cost of 5.815 cents a pound. The entire output was sold at an average of 12.876 cents a pound, or a total of $784,759.56. A dividend of $144,656.75 was paid to stockholders.

At the Fortuna property of the Montana-Bingham Co. lessees shipped 127 tons of ore, on which the net smelter return was $779.91; at the Tiewaukee copper-precipitating plant of the company 45.587 dry tons of cement copper were sold for $5,347.55. The Tiewaukee mine was the scene of most of the development work in 1924.

At the United States mines [11] a larger output of ore was possible, chiefly because more miners were available. Toward the end of 1924 the output of the mine exceeded the capacity of the Midvale concentrator. The total production, including that from the Niagara mine, amounted to 170,062 tons of complex lead-zinc ore and 2,448 tons of copper ore, as against 141,026 tons and 3,457 tons, respectively, produced in 1923.

The Utah Delaware property, formerly the Utah Consolidated or Highland Boy mine, was developed in 1924 in cooperation with the adjoining Utah Apex mine on its 2,400-foot level.

The Utah Apex Co. announced that it had found sulphide copper ore of good shipping grade on its lowest level at a depth of 2,000 feet. Many ore bodies are said to have been developed on that level, but the dimensions of this body of copper ore were not known at the end of 1924. Utah Apex ore, which heretofore has been largely lead-silver-zinc and some copper, does not form one continuous body, but occurs in fissures or pockets. The policy of the company has been to develop enough ore for a year's operation and to continue to develop ore, when found, in proportion to the quantity mined. At the end of 1924 the reserves amounted to 200,000 tons of lead ore, half of which was of shipping grade, averaging 13 per cent lead; the remainder was of milling grade, averaging 7 per cent lead. Most production and development in the mine has been done on a contract system which enabled men to earn a bonus in excess of wages.

According to the company's report for 1924 to the Bureau of Mines, three grades of ore amounting to 172,731 tons in all were mined; 120,590 tons of this amount were milled and produced 41,536 tons of concentrate which contained 1,731.68 ounces of gold, 254,831 ounces of silver, 729,193 pounds of copper, 16,977,516 pounds of lead, and 5,096,139 pounds of zinc. It is doubtful if much or any of the zinc content was paid for, but the ores which averaged 25 per cent of sulphur and 22 per cent of iron received credit for the iron in the charge for treatment. The ore of shipping grade was mostly lead sulphide and amounted to 48,297 tons, containing 1,512.40 ounces of gold, 243,831 ounces of silver, 722,926 pounds of copper, 13,420,498 pounds of lead, and 6,158,892 pounds of zinc. Unless purchasers diverted some of this ore to custom milling plants, all the zinc was probably unrecoverable.

Sulphide copper ore shipped to the smelter amounted to 3,733 tons, and contained 347.96 ounces of gold, 23,264 ounces of silver, 470,925 pounds of copper, and a little lead. All the copper ore went to a copper smelter, where some lead is saved from furnace fumes. The

[10] Ohio Copper Co. Ann. Rept. for 1924.
[11] United States Smelting, Refining & Mining Co. Ann. Rept. for 1924.

ore and concentrate were valued at $2,284,420.34; after freight and treatment charges were deducted the net value received amounted to $1,861,009.26. Dividends approximating $1,975,000 have been paid to stockholders, including $132,050 paid in 1924. In April, 1925, the eastern office of the Utah Apex Co. announced that "in the 2,417 crosscut of the 2,400 level, the lowest level opened, 3 feet of ore, assaying 16 ounces of silver to the ton, 45 per cent of lead, and 14 per cent of zinc, was opened and followed westerly."

Other producers were the Cougar, Queen (Lavagnino), New England, Bingham Coalition, Park-Bingham, Ute Copper, and the property of the Utah Metal & Tunnel Co.

Smelter district.—A number of small lots of ore reported from car and track cleanings comprise the output of the Smelter district in 1924. The Midvale smelter[12] treated 233,125 tons of marginal ore, a small decrease from 1923, which produced 40,227 tons of lead bullion. The concentrator milled 135,856 tons of lead-zinc ore, all of which, with the exception of a few lots, was mined at Bingham. The new 500-ton concentrator using flotation is expected to be completed in 1925.

SAN JUAN COUNTY

Blue Mountain district.—The Dream mine was operated and a small quantity of gold bullion recovered in the milling plant by amalgamation.

SUMMIT AND WASATCH COUNTIES

The Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County represented the producing area of the Park City region in 1924.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, in 1924

	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	13	411,792	$259,994	5,613,540	2,084,906	66,692,730	6,786,804	$10,070,748
Increase or decrease from 1923	+1	+58,470	+62,215	−343,147	+400,479	+14,252,038	−670,474	+562,932
Total, 1870–1924	-------	-------	5,303,909	161,493,112	39,879,548	1,492,890,563	88,588,202	214,017,370

Total dividends, 1870–1924, $49,411,363.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, in 1924, by kinds of ore

Kind of ore	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	4	50,350	5,243.70	1,407,905	174,486	1,048,905	----------
Lead	9	236,803	5,023.27	3,279,607	1,399,180	48,647,239	403,789
Lead-zinc	8	124,639	2,310.24	926,028	511,240	16,996,586	6,383,015
	-------	411,792	12,577.21	5,613,540	2,084,906	66,692,730	6,786,804

[12] United States Smelting, Refining & Mining Co. Ann. Rept. for year ended Dec. 31, 1924

The Silver King Coalition property[13] produced 38,147 tons of crude ore shipped directly to smelters and 76,892 tons of second-class or mill ore, a total of 115,039 tons, at a cost of $562,664, or $4.89 a ton. Hoisting and hauling the ore cost $103,409.96, or 89.9 cents a ton, making the total extraction cost $5.79 a ton. The mining development cost was $216,608.40, or $10.86 a foot, and hauling and hoisting, $38,326.10, or $1.92 a foot, a total cost of $12.78 a foot. The ore milled amounted to 75,709 tons, which yielded 11,017 tons of lead concentrate, 9,735 tons of iron concentrate, and 141 tons of zinc concentrate, which cost $145,666.15 to produce, or $1.924 a ton of ore. The sampling cost of 59,099 tons of ore, middling, and concentrate was $13,704.21, or 23.2 cents a ton, and the aerial tramway cost 28.8 cents a ton. The average contents of all products mentioned above are given in the following table:

Gold, silver, copper, lead, and zinc produced by Silver King Coalition mine, Utah, in 1924

Kind of material	Gold		Silver		Lead		Copper		Zinc		Net smelter returns
	Per ton	Total	Per ton	Total	Percentage	Total	Percentage	Total	Percentage	Total	
	Ounces	*Ounces*	*Ounces*	*Ounces*		*Pounds*		*Pounds*		*Pounds*	
First-class ore	0.0605	2,305.89	53.77	2,051,174	31.91	24,348,855	1.48	1,127,265	-----	-----	$2,571,840
Lead concentrate	.0626	690.09	34.29	377,853	37.42	8,245,933	.67	147,920	-----	-----	673,954
Iron concentrate	.0292	284.61	11.82	115,090	10.94	2,130,811	.33	64,336	-----	-----	156,563
Zinc concentrate	-----	-----	24.54	3,460	5.84	16,460	1.97	3,020	47.07	132,725	5,289
Lessees' ore	.1544	9.11	59.77	3,527	35.77	42,214	1.42	1,679	-----	-----	[a] 1,429
	-----	3,289.70	-----	2,551,104	-----	34,784,273	-----	1,344,220	-----	132,725	3,409,075

[a] Sold for $4,763.24.

Development during 1924 opened up additional ore reserves, and haulage and ventilation conditions in the mine improved. A new working shaft from the 1,300 to the 1,550 foot level was completed and laterals were extended on the 1,550-foot level to cut valuable ore bodies. The adjoining Silver King Consolidated property, recently taken over by the Silver King Coalition Co., will be worked by a separate company under the supervision of the Coalition Co. At the Coalition concentrator the flotation unit recently installed is said to have increased the efficiency of the plant, and more flotation equipment is contemplated.

The Park-Utah mine[14] produced 70,576 tons of ore, which contained 7,626 ounces of gold, 1,764,005 ounces of silver, 2,993,077 pounds of lead, 226,663 pounds of copper, and 1,303,231 pounds of zinc. All the metals except the zinc were paid for in the ore, which sold for $971,479.41, or $13.76 a ton. Dividends paid to stockholders amounted to $150,000, making a total of $1,296,036.75 since production began. Expenditures charged to the mine account amounted to $399,267.60; sampling and assaying, $45,341.42; prospecting and dead work, $222,047.78; general expense, $115,586.32; and construction, $4,163.29.

[13] Silver King Coalition Mines Co. Ann. Rept. for year ended Dec. 31, 1924.
[14] Park-Utah Mining Co. financial statement for year ended Dec. 31, 1924.

The output of ore from the Keystone mine[15] came from between the 300 and 400 levels. From 30,072 tons of ore in the flotation mill 5,497 tons of lead concentrate and 1,222 tons of zinc-iron middling were saved. The ore milled assayed 0.016 ounce of gold and 3.3 ounces of silver to the ton, 8.5 per cent of lead, and 5.1 per cent of zinc. The lead concentrate assayed 0.078 ounce of gold and 13.9 ounces of silver to the ton, 34.7 per cent of lead, and 7 per cent of zinc (not paid for), and sold for a total of $281,094. The zinc-iron middling assayed 0.029 ounce of gold and 4.32 ounces of silver to the ton, 6.7 per cent of lead, and 19.5 per cent of zinc, and sold for a total of $9,547. The first-class crude ore, of which 10,878 tons assayed 0.016 ounce of gold and 10.1 ounces of silver to the ton, 25.7 per cent of lead, and 7 per cent of zinc, was sold for $337,279, exclusive of the zinc. The total received for the mine output was $627,921. Mining cost $225,090, milling $55,675, surface expense $10,919, ore transportation and sale $67,209, construction work $27,974, administrative expense $29,577, or a total of $416,444; the operating profit was $211,477.

The Park City Mining & Smelting Co.[16] sold 54,844 tons of ore, concentrates, and scrap lead from its dismantled electrolytic zinc refinery for $1,916,033.12. The crude ore (18,527 tons) averaged 0.036 ounce of gold and 21.21 ounces of silver to the ton, and 21 per per cent of lead, 1.02 per cent of copper, and 10 per cent of zinc, and sold for $32.05 a ton. The milling ore that yielded concentrate amounted to 99,054 tons. Lead concentrate, of which 27,165 tons were shipped, contained an average of 0.034 ounce of gold and 18.56 ounces of silver to the ton, 28.47 per cent of lead, 0.71 per cent of copper, and 9.25 per cent of zinc, and sold for $43.35 a ton.

Zinc concentrate amounted to 9,043 tons and contained 0.018 ounce of gold and 9.85 ounces of silver to the ton, 5.88 per cent of lead, 0.83 per cent of copper, and 34.5 per cent of zinc, and sold for $19.39 a ton. In its annual report the company gives the total content of all products sold in 1924 as follows: 1,723 ounces of gold, 1,132,351 ounces of silver, 23,485,355 pounds of lead, 1,109,013 pounds of copper, and 15,521,350 pounds of zinc. Payment was received for less than one-third of the zinc; the remainder was lost in smelting. Dividends paid to stockholders amounted to $525,600.

The Ontario mine, under the control of the Park City Mining & Smelting Co., was operated during 1924; about 10,500 tons of ore of smelting and milling grade, including tailings from the old mill, was shipped.

Lessees continued to treat old mill tailings by concentration and flotation. More than 500 tons of concentrate containing lead, silver, copper, and gold were shipped to the smelter.

TOOELE COUNTY

Twenty-nine producers in Tooele County reported the output of 90,885 tons of ore, or 12,864 tons more than was reported by 23 producers in 1923. The gold decreased from $23,632 to $17,094, the silver from 478,033 to 331,989 fine ounces, the copper from 1,000,562

[15] Keystone Mining Co. Ann. Rept. for 1924.
[16] Park City Mining & Smelting Co. financial statement for year ended Dec. 31, 1924.

to 403,093 pounds, the lead from 9,874,472 to 6,615,007 pounds, and the zinc from 96,965 to 22,860 pounds. The total value of all metals decreased from $1,260,509 to $823,018.

Cave Springs district.—The Lark group of claims 20 miles northeast of Wendover produced a little lead ore containing 57.95 ounces of silver to the ton, and 37.7 per cent of lead, 1.4 per cent of zinc, and 5.2 per cent of iron.

Clifton district (Gold Hill).—Seven properties in the Clifton district produced 33,094 tons of ore, containing $10,564 in gold, 147,786 ounces of silver, 3,615 pounds of copper, and 1,840,453 pounds of lead, valued in all at $257,290, or $7.77 a ton. The ore output included 5,882 tons of lead ore and 27,212 tons of dry and siliceous ore, of which arsenic ore was a part. The white arsenic in the ore, computed at the price paid producers, amounted to $810,282. All the arsenical ore and a little lead ore was produced from two properties operated by the Western Utah Copper Co. and the United States Smelting, Refining & Mining Co. Lead ore containing silver was shipped by lessees from the Garrison Monster mine on Dutch Mountain, about 6 miles north of Gold Hill. The Rube mine continued to produce rich gold ore taken out by the owner, and several lots were shipped averaging 9 ounces of gold and 4 ounces of silver to the ton. This ore carries less than 2 per cent of lead, 26 per cent of insoluble, 1 per cent of zinc, 8 per cent of iron, and 21.21 per cent of lime.

The United States Smelting, Refining & Mining Co. purchased the property of the Toledo-Gold Hill Mining & Milling Co. in 1924. This property adjoins the Gerster Last Dollar claims, in which large deposits of arsenopyrite and scorodite were opened in 1924. The Gold Hill mine of the Western Utah Copper Co. was under a long-time lease to the American Smelting & Refining Co. and is said to have 120,000 tons of arsenical ore developed, most of it between the 600 and 700 foot levels. Recent work at 775 feet indicates a permanent water level.

Columbia district.—Lessees at the old Sharp mine produced lead ore containing silver, iron, and zinc.

Dugway district.—Ore containing zinc, lead, and a little silver was hauled by motor truck from the Four Metals mine 80 miles to the Combined Metals mill at Bauer.

Lakeside district.—Lead-silver ore from the Monarch mine was shipped to the smelter from Delle, on the Western Pacific Railroad.

Ophir district.—Eight producers in the Ophir district reported the output of 52,998 tons of ore, which contained $2,946 in gold, 154,755 ounces of silver, 387,842 pounds of copper, and 2,828,812 pounds of lead, valued in all at $383,744, or $7.24 a ton. Most of the ore was milled and produced lead concentrate and zinc concentrate, and only 502 tons were ore of shipping grade. The output of the district includes about 8,000 tons of tailings whose metal content is included in the total.

Rush Valley district (Stockton).—Six producers in the Rush Valley district reported the output of 4,549 tons of ore, which contained $3,575 in gold, 26,519 ounces of silver, 10,198 pounds of copper, 1,851,687 pounds of lead, and 16,354 pounds of zinc, valued at $171,877 in all, or $37.78 a ton. The main part of the output came

from the Galena King mine, worked by the Keystone Development Co. This ore contained lead and silver with a little gold. The Stockton Lead Co., operating the Cyclone mine, was the next largest ore producer; the ore was shipped to Tooele. Lessees at the Honorine or Bullion Coalition property produced considerable lead ore and some zinc ore; the latter was treated at the plant of the Combined Metals Reduction Co., at Bauer. The process used in reducing these ores is described elsewhere (p. 485).

Silver Islet district.—Lead ore containing silver was shipped to the smelter from the Utah Silver Lake property.

Wild Cat Range district.—Lessees at the Silver Queen property shipped a small lot of silver ore containing copper. Some fluorspar was mined, and all that was in the stock pile at the property was sold.

UTAH COUNTY

American Fork district.—Seven producers in the American Fork district reported the output of 1,961 tons of ore, of which 940 tons were of shipping grade and 1,021 tons were treated in a concentration mill and yielded lead concentrate. Some ore containing considerable zinc was shipped to a milling plant in the Salt Lake Valley. The total metal output was valued at $66,502, or $33.91 a ton.

Mine production of gold, silver, copper, lead, and zinc in American Fork district, Utah, in 1924

	Number of producers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1924	7	1,961	$11,045	15,528	76,670	378,342	72,957	$66,502
Increase or decrease from 1923	+4	+101	−19,822	+7,945	−65,382	+287,083	−47,897	−6,070
Total, 1870–1924	-------	80,872	326,218	1,956,570	442,987	30,672,970	240,722	4,215,492

North Tintic district.—From the Lehi Tintic property one lot of lead ore containing a little silver was hauled 8 miles to Topliff, on the Denver & Rio Grande Western Railroad, and shipped to the smelter.

Tintic district.—On the Utah County side of the Tintic district are the mines of the Tintic Standard, Colorado Consolidated, Apex Standard, Iron King, and Sioux companies. All produced considerable ore and the total is included in the total output of the district shown under Juab County.

WAYNE COUNTY

Henry Mountain district.—Sluicing operations on the high gravel bars of the Colorado River resulted in the production of a little bullion having a fineness of 0.906 in gold.

GOLD AND SILVER

(GENERAL REPORT)

By J. P. Dunlop

PRODUCTION

DOMESTIC PRODUCTION

Approximate distribution, by producing States and Territories, of the production of gold and silver in the United States in 1924

[Figures supplied by the U. S. Bureau of the Mint]

State or Territory	Gold		Silver	
	Fine ounces	Value [a]	Fine ounces	Value [b]
Alaska	303,553	$6,275,000	690,781	$462,823
Arizona	226,385	4,679,800	6,390,684	4,281,758
California	633,021	13,085,700	3,598,733	2,411,153
Colorado	420,858	8,699,900	3,549,903	2,378,435
Georgia	24	500		
Idaho	27,085	559,900	8,036,358	5,384,359
Illinois			9,500	6,365
Michigan			155,372	104,099
Missouri			86,201	57,754
Montana	95,815	1,980,700	13,688,728	9,171,447
Nevada	219,976	4,547,300	9,333,197	6,253,242
New Mexico	26,742	552,800	834,933	559,405
North Carolina	97	2,000	24	16
Oregon	27,622	571,000	45,143	30,246
Pennsylvania	213	4,400	2,800	1,876
Philippine Islands	82,562	1,706,700	40,346	27,032
Porto Rico	10	200	11	7
South Dakota	297,085	6,141,300	89,417	59,909
Tennessee	329	6,800	95,542	64,013
Texas			718,425	481,345
Utah	153,378	3,170,600	17,821,716	11,940,551
Virginia	5	100		
Washington	14,130	292,100	219,372	146,979
Wyoming	10	200		
	2,528,900	52,277,000	65,407,186	43,822,814

[a] Gold valued at $20.67+ a fine ounce.
[b] Silver valued at 67 cents a fine ounce. Average New York price of bar silver.

The figures in this table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Increase or decrease in production of gold and silver in the United States in 1924

State or Territory	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Alaska	−11,407	−$235,800	−125,396	−$206,442
Arizona	−70,052	−1,448,100	−986,148	−1,767,244
California	−18,348	−379,300	−91,123	−614,529
Colorado	+105,172	+2,174,100	−1,979,218	−2,155,444
Georgia	−10	−200		
Idaho	−8,679	−179,400	+16,381	−1,192,022
Illinois			−675	−1,978
Michigan			−98,333	−103,939
Missouri			−81,251	−79,557
Montana	+10,670	+220,600	−537,544	−2,494,096
Nevada	+21,561	+445,700	−1,307,459	−2,472,096
New Mexico	+3,014	+62,300	+97,070	−45,643
North Carolina	+44	+900	−55	−49
Oregon	+3,991	+82,500	−30,440	−31,732
Pennsylvania	+82	+1,700	+1,522	+828
Philippine Islands	+6,425	+132,800	+986	−5,243
Porto Rico	+5	+100	−173	−144
South Carolina	−14	−300		
South Dakota	−9,927	−205,200	−6,405	−18,665
Tennessee	+10	+200	−13,544	−25,437
Texas	−44	−900	−106,842	−195,374
Utah	−3,613	−74,700	−2,657,834	−4,852,680
Virginia	+5	+100		
Washington	−2,603	−53,800	−21,340	−50,405
Wyoming	−14	−300	−163	−134
	+26,268	+543,000	−7,927,984	−16,312,025

Domestic smelters and refiners recovered 794,158 fine ounces of gold and 72,236,546 fine ounces of silver from foreign ore and bullion, a decrease of 4,044 ounces of gold and of 2,212,308 ounces of silver compared with the corresponding figures for 1923. The foreign ore came mainly from Mexico, Canada, and Peru.

The value of the new gold used in the arts and industries in the United States in 1924 was $37,913,310, compared with $40,013,175 in 1923, and the quantity of new silver used for such purposes was 24,664,236 fine ounces, compared with 28,355,171 ounces. The consumption of new silver in the arts and industries in 1924 was equal to 38 per cent of the domestic production, and that of gold to 73 per cent of the domestic production. In addition to the gold and silver derived from foreign and domestic ore and bullion, $27,974,541 in gold and 8,930,580 fine ounces of silver were recovered from old jewelry, dental waste, silverware, and other old material. Of this, $12,960,889 in gold and 5,720,626 ounces of silver were handled by private refineries.

PRICES OF SILVER

The average monthly prices of fine bar silver in New York in 1924 were as follows:

Price of silver per fine ounce in 1924, by months

January	$0.63781	August	$0.68865
February	.64652	September	.69680
March	.64293	October	.71168
April	.64403	November	.69636
May	.65860	December	.68459
June	.67045		
July	.67497	Average	.67111

The yearly price of silver trended downward, steadily in the main, from $1.337 and $1.339 in 1865 and 1866 to a low point of $0.507 in 1915. After that date the trend was upward until 1923. The price has been unusually stable since purchases under the Pittman Act ceased. The average yearly price over the period 1865 to 1924 was $0.9077.

Price of domestic silver per fine ounce, 1914–1924 [1]

1914	$0. 553	1920	$1. 09
1915	. 507	1921	1. 00
1916	. 658	1922	1. 00
1917	. 824	1923	. 82
1918	. 980	1924	. 67
1919	1. 12		

PRODUCTION OF GOLD AND SILVER SINCE 1792

Gold and silver produced in the United States, 1792–1924

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value	Fine ounces	Commercial value
1792–1847 [a]	1, 186, 977	$24, 537, 000	309, 500	$404, 500
1848–1872	58, 279, 781	1, 204, 750, 000	118, 568, 200	157, 749, 900
1873–1924	148, 342, 678	3, 066, 515, 300	2, 688, 548, 741	2, 140, 930, 178
	207, 809, 436	4, 295, 802, 300	2, 807, 426, 441	2, 299, 084, 578

[a] A careful investigation made by Philip B. Bekeart (Soc. California Pioneers Quarterly, Sept. 30, 1924) appears to have definitely fixed Jan. 19, 1848, as the date of the discovery of gold by James W. Marshall at Sutters Mill, Coloma, Eldorado County, Calif., and to have shown that the first flakes (not a nugget) found by Marshall are now in the National Museum, Washington, D. C.

Although the output of gold during the period 1792–1924 was less than one-fourteenth the output of silver in quantity, its value was nearly twice that of the silver.

The average commercial value per fine ounce of silver for the 132 years contributing to the total domestic production was $0.8189. Fluctuations in value of silver per fine ounce are shown in the curve in Figure 14.

[1] Based on London price of bar silver 1.000 fine and taken at average price and par of exchange, 1914–1915; New York dealers' buying price for 1916–1919; average buying price of silver from domestic mines for 1920 to June 2, 1923; average New York price for all silver after that period.

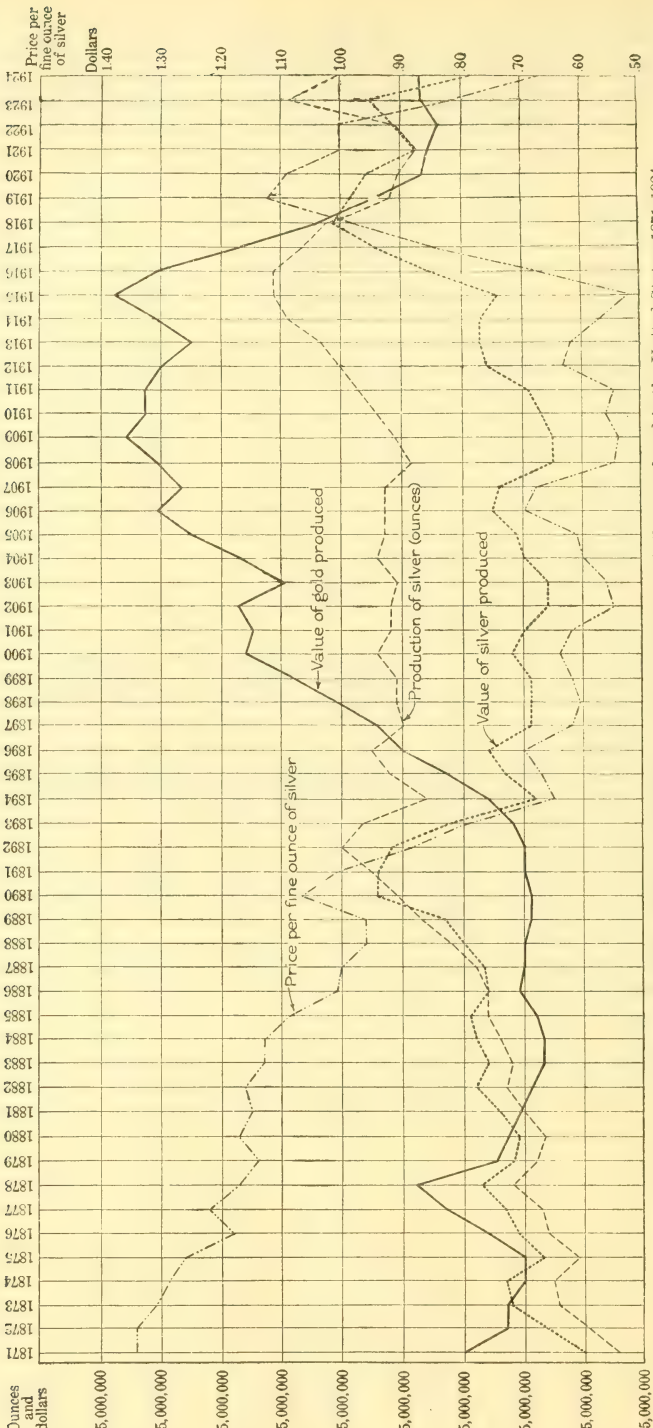


FIGURE 14.—Quantity and value of gold and silver produced and price per fine ounce of silver produced in the United States, 1871-1924

IMPORTS AND EXPORTS

Value of gold and silver imported into and exported from the United States, 1923–24 [a]

	Imports	Exports	Excess of—	
			Imports	Exports
1923				
Gold:				
Contained in domestic ore and base bullion		$248,771		$248,771
Contained in foreign ore and base bullion	$24,048,777		$24,048,777	
Domestic bullion refined		19,769,016		19,769,016
Foreign bullion refined	186,123,382	66	186,123,316	
United States coin	37,488,237	7,848,658	29,639,579	
Foreign coin	75,055,416	776,906	74,278,510	
	322,715,812	28,643,417	314,090,182	20,017,787
Excess of imports over exports			294,072,395	
Silver:				
Contained in domestic ore and base bullion		45,225		45,225
Contained in foreign ore and base bullion	40,342,858		40,342,858	
Domestic bullion refined		40,127,961		40,127,961
Foreign bullion refined	31,249,574	28,935,369	2,314,205	
United States coin	841,655	214,012	627,643	
Foreign coin	2,019,443	3,146,222		1,126,779
	74,453,530	72,468,789	43,284,706	41,299,965
Excess of imports over exports			1,984,741	
1924				
Gold:				
Contained in domestic ore and base bullion		245,817		245,817
Contained in foreign ore and base bullion	22,589,649		22,589,649	
Domestic bullion refined		26,838,091		26,838,091
Foreign bullion refined	196,009,351	21	196,009,330	
United States coin	29,213,499	33,225,446		4,011,947
Foreign coin	71,908,419	1,338,938	70,569,481	
	319,720,918	61,648,313	289,168,460	31,095,855
Excess of imports over exports			258,072,605	
Silver:				
Contained in domestic ore and base bullion		28,650		28,650
Contained in foreign ore and base bullion	38,919,408		38,919,408	
Domestic bullion refined		90,851,274		90,851,274
Foreign bullion refined	33,441,610	14,225,232	19,216,378	
United States coin	683,023	280,465	402,558	
Foreign coin	900,861	4,505,412		3,604,551
	73,944,902	109,891,033	58,538,344	94,484,475
Excess of exports over imports				35,946,131

[a] According to Bureau of Foreign and Domestic Commerce.

DOMESTIC SUPPLY

The remarkable gain in the domestic supply of gold, indicated by the great excess of $530,000,000 in imports over exports in 1916, of $180,000,000 in 1917, and of $21,000,000 in 1918, had come to a halt in the early part of 1919 but was resumed in 1920, owing to large imports of foreign bullion and coin. This excess was $667,000,000 in 1921, $238,000,000 in 1922, and $294,000,000 in 1923. In 1924 the excess was $258,000,000. Most of the imports were received early in the year. They were small at the end of the year and exports to the Orient increased.

The domestic supply of new gold comes chiefly from dry and siliceous gold ore, treated mainly by amalgamation or cyanidation, or both, and partly by smelting, and from placer gravel worked largely by dredges. As shown on page 527 this ore and the placer gravel supplied 84 per cent of the yield of gold in 1924, against 86 per cent in 1923. Considerable gold is usually recovered also from the refining of copper bullion from copper ore, especially in the West Mountain or Bingham district, Utah, and the Summit Valley or Butte district, Mont.

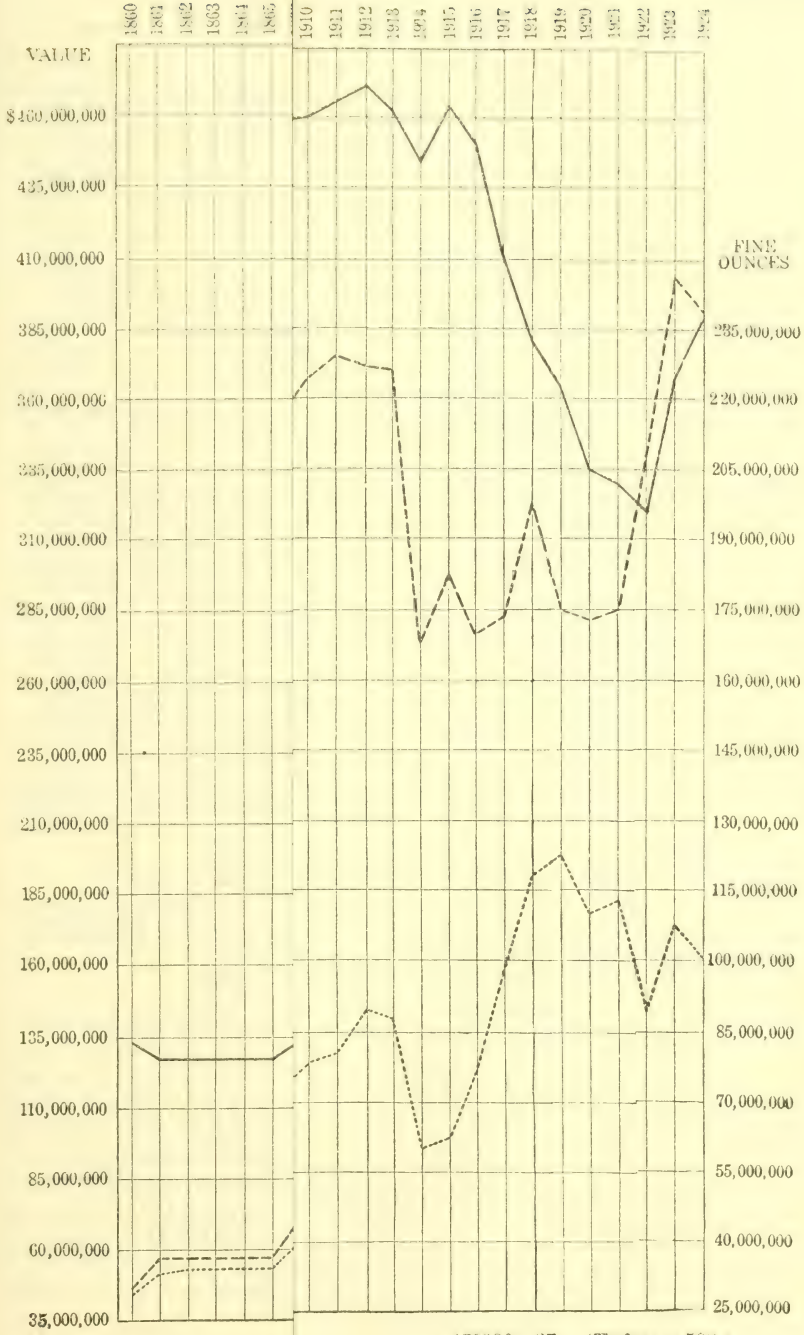
In 1924 the copper ore of the United States produced 12.7 per cent of the total gold, against 2.25 per cent in 1921, 5.71 per cent in 1922, and 11.3 per cent in 1923. The natural tendency has been for the proportionate output from gold ore to decrease with declining yield from some of the principal gold camps, and for that from copper ore to increase, with a general net decline of total yield of gold owing to the preponderant output from gold and gold-silver ores.

The chief domestic supply of new silver came from dry and siliceous silver and silver-gold ores, lead ore, copper ore, and lead-zinc ore, in the proportion of 31.82, 29.43, 25.50, and 11.27 per cent, respectively, in 1924, against 39.28, 28.63, 20.87, and 6.14 per cent in 1923. The greater part of the dry and siliceous silver ore is milled and cyanided at or near the mines, but a small quantity of richer ore is shipped to copper and lead smelters.

WORLD'S PRODUCTION OF GOLD

The estimated value of the gold produced in the world from 1860 to 1924, inclusive, was $15,081,683,600. In 1924 the estimated production of the world was $389,169,700, an increase of $21,316,300 over that of 1923. This increase followed a period of successive annual decreases from 1915 to 1922, and an increase of $48,433,300 in 1923. The production in 1924 in the United States increased $543,000. In Africa the increase was $9,276,300, or 44 per cent of the total increase in world output. The production in Canada increased about $6,000,000, or 24 per cent. The large increase in the Rand mines in South Africa was due to the absence of labor troubles and to the steady working of the mines all the year.

The prevailing tendency during recent years toward a declining world output of new gold, caused by the high cost of labor and supplies, which made the operation of many gold mines unprofitable, has been modified to some extent by greater political and financial stability in some countries, which will tend to increased operations or the reopening of old properties. This will temporarily result in relatively small increases over the abnormally low output of gold from these countries in the last six or seven years. In the following table is shown the output of gold by countries, as given by the Bureau of the Mint with slight changes resulting from late information.



47892°—27. (To face p. 508.)

FIGURE 15. Quantity and value of gold and silver produced in the world, 1860–1924

47892° 27. (To face p. 508.)

World's production of gold, 1919–1924

Country	1919	1920	1921	1922	1923	1924
North America:						
Canada	$15,850,400	$15,853,500	$19,148,900	$26,116,000	$25,495,400	$31,532,400
Central America	3,300,000	3,000,000	2,500,000	2,500,000	2,000,000	1,800,000
Mexico	15,676,500	15,265,900	14,152,600	15,169,200	16,158,400	16,480,100
United States [a]	60,333,400	51,186,900	50,067,300	48,849,100	51,734,000	52,277,000
South America:						
Argentina	4,000	100,000	75,000	75,000	80,000	80,000
Bolivia	5,000	5,000	6,000	8,400	8,400	19,900
Brazil	2,000,000	2,600,000	2,780,000	3,031,900	2,990,700	2,990,700
Chile	765,000	900,000	933,100	1,650,200	1,331,200	1,400,000
Colombia	6,000,000	5,800,000	6,000,000	5,700,000	5,700,000	5,500,000
Ecuador	800,000	750,000	749,500	877,600	877,600	800,000
Guiana—						
British	335,200	200,000	265,200	224,800	168,900	131,000
Dutch	329,300	258,500	233,300	247,900	263,200	214,000
French	1,100,000	900,000	1,000,000	1,008,200	922,500	1,312,600
Peru	1,348,400	1,297,300	1,599,700	1,683,400	2,488,300	2,488,300
Uruguay	10,000	400	7,000	7,000	200	200
Venezuela	600,000	389,400	625,400	358,900	358,900	358,900
Europe:						
Austria			3,300	11,300	15,300	40,500
Czechoslovakia	125,600	181,100	235,900	171,400	69,100	69,100
France	151,000		49,100	332,300	350,200	409,400
Germany		91,700	86,400	112,300	132,900	132,900
Great Britain		700				
Greece	4,600	10,600		8,600	8,600	8,000
Italy	15,300	15,000			25,200	358,900
Rumania			856,000	888,500	996,900	871,300
Russia and Siberia	11,000,000	1,182,900	892,600	3,032,600	5,181,900	11,863,100
Spain				18,700	18,700	20,000
Sweden	10,000	4,700	1,300	700		
Turkey				29,900	29,900	19,300
Yugoslavia		66,500	82,400	143,500	126,900	161,500
Asia:						
China	3,300,000	2,584,000	2,067,200	2,067,200	1,850,100	2,218,100
Chosen	2,800,000	1,571,100	2,705,800	2,643,800	2,510,200	2,480,600
East Indies—						
British	650,000	600,000	500,000	600,000	600,000	500,000
Dutch	1,914,000	1,879,500	1,946,600	2,156,000	2,388,600	2,571,300
Federated Malay States	339,000	265,700	276,700	310,200	190,000	309,300
India, British	10,486,000	10,316,700	8,945,200	9,054,600	8,729,900	8,193,300
Indo-China	40,000	3,300	3,300	99,700	128,300	128,300
Japan	4,824,900	5,130,400	4,901,400	4,833,300	5,111,700	5,111,600
Sarawak	446,000	338,000	353,300	22,700	20,800	17,700
Taiwan	417,200	279,000	588,200	453,900	453,900	175,800
Africa	193,896,500	191,339,800	186,968,400	165,774,100	209,954,000	219,230,300
Australasia	26,911,500	22,651,700	18,672,700	18,847,200	18,382,600	16,894,300
	365,788,800	337,019,300	330,278,800	319,420,100	[b]367,853,400	[c]389,169,700

[a] Includes Philippine Islands.
[b] Revised figures.
[c] Revised figures will be given in the report for 1925.

WORLD'S PRODUCTION OF SILVER

The figures for the world's production of silver in 1924 show that the United States and Canada produced 36 per cent of the total, against 37 per cent in 1923, and that Mexico, Central America, and South America produced 50 per cent, so that only 14 per cent (33,092,300 ounces) came from all other countries, mainly from Australasia, Burma, Germany, Japan, Spain, and Dutch East Indies. The total decrease in the world's production was 6,942,770 ounces. The average monthly open-market price ranged from $0.63781 per ounce to $0.71168. The value of the silver produced in the world in 1924, at $0.67 a fine ounce, was about $160,175,800, and the total value from 1860 to 1924, inclusive, was $6,560,247,400.

World's production of silver, 1919–1924, in fine ounces

Country	1919	1920	1921	1922	1923	1924
North America:						
Canada	16,020,700	12,793,500	13,134,900	18,581,400	17,754,700	19,736,300
Central America	2,800,000	2,700,000	2,000,000	2,000,000	2,500,000	2,686,200
Mexico	65,904,200	66,662,200	64,465,400	81,076,900	90,859,100	91,486,100
United States [a]	56,682,400	55,361,600	53,052,400	56,240,100	73,335,200	65,407,200
South America:						
Argentina	25,000	30,000	25,000	25,000		
Bolivia	2,435,000	2,200,000	2,758,900	5,373,500	5,212,800	4,534,800
Brazil	25,000	30,000	33,000	25,700	28,600	28,600
Chile	1,900,000	2,604,400	2,200,000	2,709,200	3,337,500	3,357,700
Colombia	494,300	480,000	500,000	3,200	3,100	2,900
Ecuador	40,000	35,000	75,000	75,000	75,000	70,000
Guiana	8,000	8,000	9,000	9,000	8,500	8,700
Peru	9,821,700	9,196,300	10,008,600	13,169,800	18,654,800	18,654,800
Uruguay		500	2,000	2,000		
Venezuela	4,100	3,500	2,700	2,700	2,700	2,700
Europe:						
Austria	15,400	14,000	10,500	8,600	14,200	28,700
Czechoslovakia	581,000	680,100	703,100	875,200	702,300	702,300
France	12,000	321,500	321,500	209,000	213,000	147,900
Germany		3,305,000	3,387,400	3,581,500	3,753,000	3,753,000
Great Britain	68,400	76,400	11,300	27,600	34,600	31,200
Greece	160,000	220,900		184,100	184,100	160,800
Italy	350,000	297,500	199,300	204,700	385,800	427,600
Norway	312,800	323,200	196,100	205,200	297,900	424,400
Rumania			96,500	83,300	84,800	446,100
Russia	400,000	50,000	40,000	150,000	192,900	200,000
Serbia	20,000					
Spain	1,548,200	2,956,500	2,679,400	2,778,200	2,778,200	2,880,000
Sweden	31,500	11,600	13,300		600	
Turkey	100,000	100,000	100,000	8,000	8,000	219,900
Yugoslavia		15,000	15,900	26,800	24,600	31,300
Asia:						
Burma	1,975,000	2,700,000	3,437,600	4,094,300	4,713,100	5,159,000
China	65,000	50,000	40,000	100,000	100,000	110,000
Chosen	20,000	1,200	3,000	10,700	39,300	50,000
East Indies, Dutch	1,006,800	1,027,900	1,022,000	1,109,600	1,579,000	2,083,300
India, British	190,600	170,600	150,000	150,000	150,000	150,000
Indo-China	1,000					
Japan	4,950,500	4,892,400	4,187,700	3,886,300	3,597,400	3,534,900
Sarawak	6,300	5,200	3,400	500		
Taiwan	25,000	20,000	26,500	23,400	23,400	11,000
Africa:						
Algeria	170,800	150,000				
Belgian Congo	10,000	10,700	5,800	6,500	8,700	
British West Africa (Gold Coast, Ashanti, Nigeria)					70	
East Africa, French	17,700	13,800	12,900	12,900		
East Africa, Portuguese	1,000	700	500	500		
Egypt	300	300				
Rhodesia	180,600	164,900	161,900	184,400	161,500	401,300
Tanganyika						700
Transvaal, Cape Colony, Natal	891,300	891,300	830,800	1,115,700	1,373,900	1,399,600
Australasia	7,188,000	2,684,900	5,362,200	11,484,900	13,818,700	10,739,300
	176,459,600	173,260,600	171,285,500	209,815,400	[b] 246,011,070	[c] 239,068,300

[a] Includes Philippine Islands.
[b] Revised figures.
[c] Revised figures will be given in the report for 1925.

Most of the world's output of silver is produced or refined in the United States, but a large part of it is consumed in Great Britain, India, and China, and the price of silver has been dominated by the London market. Silver, its Romance and History, by Benjamin White, which contains information relating to the buying and selling of silver and the fixing of market quotations, was quoted in the chapter on gold and silver in Mineral Resources for 1918.

A meeting of the American Silver Producers Association in Salt Lake City on August 10, 1925, was fully attended by representatives of nearly all the larger American producers of silver.

Advisers of the association contended that about 14,500,000 ounces of silver is yet unpurchased by the United States Treasury under the terms of the Pittman Act, and assurance was given that an act would be introduced in Congress authorizing such purchase. Other matters acted on were the authorization of a joint advertising campaign with national fabricators of silver. In March, 1925, work was suspended by the Senate Comission on Gold and Silver Inquiry, through the failure of Congress to appropriate further funds for the investigation. In consequence this committee is unable to compile and publish data supplied by most of the larger operators of mines relating to the operation of gold, silver, and other mines, including comprehensive material on the costs of mining and milling. Inability to complete the investigation is unfortunate, because the data supplied by the operators cost them considerable money to compile. It is hoped that some method will be devised by which publication may be made of the valuable information collected by the commission. It was stated that the organization represents in its membership an annual production of about 100,000,000 ounces of silver, or about half of the world's production.

Prices of silver in foreign countries were higher in 1924 than in 1923, and it is estimated that European coinage absorbed 45,000,000 to 50,000,000 ounces of silver. The quantity of silver supplied from the remelting of old coinage and by debasement of new issues was only about one-half as much in 1924 as in 1923. The total quantity of silver used in the arts and manufactures was only a little less than in 1923. The use of silver in the photographic and chemical industries increased about 10 per cent. The exports of silver to China in 1924 were much less than in 1923 and stocks of silver accumulated there owing to disturbed political conditions, causing stagnation of trade. Fortunately agricultural conditions in India were excellent and unusually large quantities of silver were exported there in settlement of foreign balances. Conditions in China and India were unchanged in the early part of 1925, so that the market for silver has been very stable. In 1925, the efforts of European countries to stablize their currencies by the issue of subsidiary silver coinage, led to absorption of large quantities of silver. With this condition and no large increase in silver production probable, silver should benefit by the gradual restoration of world trade, though India and China still remain the controlling factors in the consumption of silver bullion.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the final official figures of the production of gold and silver in the United States in 1924 as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the year, these figures record the production of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace this total gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines makes a systematic investigation of the "mine production" of ores containing gold and silver and of the output of the placer mines, the output being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two plans for ascertaining the gold and silver production, one is a measure of the mining industry and the other a measure of the metallurgic industry; one reports the mine output and its recoverable content and the other the metal actually recovered in marketable form. The two methods will not produce exactly corresponding results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–1924, according to mint and to mine returns

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
		Ounces		*Ounces*
1905–1915	$1,038,286,100	671,818,275	$1,031,369,692	672,280,562
1916	92,590,300	74,414,802	92,822,430	78,875,176
1917	83,750,700	71,740,362	82,032,745	70,665,531
1918	68,646,700	67,810,139	67,701,936	68,063,090
1919	60,333,400	56,682,445	58,225,112	51,907,869
1920	51,186,900	55,361,573	50,537,281	56,559,022
1921	50,067,300	53,052,441	49,788,750	46,359,147
1922	48,849,100	56,240,048	48,932,109	61,235,983
1923	51,734,000	73,335,170	51,400,382	70,393,639
1924	52,277,000	65,407,186	52,180,812	64,113,882
	1,597,721,500	1,245,862,441	1,584,991,249	1,240,453,901

These figures show, according to the reports of the mint, a total excess of gold for the 20 years of $12,730,251, or a difference of 0.8 per cent, and a total excess of silver of 5,408,540 ounces, or a difference of 0.43 per cent. The small differences are fully accounted for in the detailed discussions of the subject in previous reports of this series.

UNITS OF MEASUREMENT

In the measurement of ores and concentrates the short ton of 2,000 pounds is used throughout. The price of gold is fixed by law at $20.67+ per fine ounce. The annual average prices for silver from 1914 to 1924 are given on page 505.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES

Mine production of gold and silver in the United States in 1924

State or Territory	Gold		Silver		Increase or decrease from 1923	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver (fine ounces)
Alabama					−$114	−1
Alaska	304,071.90	$6,285,724	669,641	$448,659	+300,410	−145,008
Arizona	235,995.74	4,878,465	6,649,276	4,455,015	−1,242,656	−694,466
California	636,139.72	13,150,175	3,555,133	2,381,939	−228,838	−4,310
Colorado	415,691.98	8,593,116	3,254,370	2,180,428	+2,001,487	−2,080,118
Georgia	31.68	655	5	3	+126	+3
Idaho	26,921.80	556,523	7,793,154	5,221,413	−210,904	+119,492
Illinois			8,891	5,957		+721
Michigan			130,381	87,355		−93,616
Missouri			103,694	69,475		−73,576
Montana	97,854.16	2,022,825	13,289,303	8,903,833	+264,077	−91,559
Nevada	217,962.56	4,505,686	9,411,379	6,305,624	+282,577	−1,203,185
New Mexico	24,803.56	512,735	795,070	532,697	−38,978	+47,943
North Carolina and South Carolina [a]	219.63	4,540	31	21	+3,125	−48
Oregon	26,695.36	551,842	38,103	25,529	+53,834	−58,219
Pennsylvania	214.01	4,424	2,810	1,883	+1,178	−195
Philippine Islands	79,905.63	1,651,796	43,127	28,895	−34,531	+5,346
Porto Rico	9.68	200	11	7	+100	−173
South Dakota	295,930.24	6,117,421	86,548	57,987	−288,885	−9,296
Tennessee	328.95	6,800	94,779	63,502	+185	−10,933
Texas			720,739	482,895	−802	−91,085
Utah	146,486.85	3,028,152	17,253,692	11,559,974	−48,331	−1,883,778
Virginia	5.61	116	3	2	+116	+3
Washington	14,977.72	309,617	213,742	143,207	−32,450	−13,445
Wyoming					−296	−254
	2,524,246.78	52,180,812	64,113,882	42,956,300	+780,430	−6,279,757

[a] No production from South Carolina in 1924.

The preceding table gives the quantity and value of the gold and silver ("mine production") by States reported from the producing mines in 1924 to the Bureau of Mines and the increase or decrease by comparison with the corresponding figures for 1923.

The increase of $780,430 in the mine production of gold in 1924 followed an increase of $2,468,273 in 1923 and decreases of $856,641 in 1922, $748,531 in 1921, $7,687,831 in 1920, $9,476,824 in 1919, $14,330,809 in 1918, and $10,789,685 in 1917. The decrease of 6,279,757 ounces in silver in 1924 followed increases of 9,157,656 ounces in 1923 and 14,876,836 ounces in 1922.

The principal gold-producing States in 1924 were California, Colorado, Alaska, South Dakota, Arizona, and Nevada, and these six States made 83 per cent of the total output. The notable increases in gold were in Alaska, Colorado, Montana, Nevada, and Oregon. The most notable decreases in gold were in Arizona, California, Idaho, New Mexico, Philippine Islands, South Dakota, Utah, and Washington.

The principal silver-producing States in 1924 were Utah, Montana, Nevada, Idaho, Arizona, California, and Colorado, and these seven States produced 95 per cent of the total.

About $29,947,000 in gold, or 57 per cent of the entire output in the United States in 1924, was produced by 25 companies, none of which produced less than $535,000. The largest producer was the celebrated Homestake mine, in South Dakota. Eighteen of these large properties produced gold from dry and siliceous ore, two

produced it from gravel by dredging, four from copper ore, and one from copper ore and siliceous ore. Eight were in California, five in in Colorado, four each in Arizona and Nevada, and one each in Alaska, Montana, South Dakota, and Utah.

Larger producers of gold in the United States in 1924, in order of output

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co.	South Dakota	Whitewood	Dry and siliceous ore.
2	Cresson Consolidated Gold Mining & Milling Co.	Colorado	Cripple Creek	Do.
3	Alaska Juneau Mining Co.	Alaska	Juneau	Do.
4	Yuba Consolidated Goldfields	California	Marysville	Dredging gravel.
5	Utah Copper Co.	Utah	West Mountain	Copper ore.
6	Portland Gold Mining Co.	Colorado	Cripple Creek	Dry and siliceous ore.
7	Natomas Co. of California	California	Oroville and Folsom	Dredging gravel.
8	Empire Mines Co.	do.	Grass Valley	Dry and siliceous ore.
9	North Star Mines Co.	do.	do.	Do.
10	United Verde Copper Co.	Arizona	Verde	Copper ore and siliceous ore.
11	Comstock Merger Mines Co.	Nevada	Comstock	Dry and siliceous ore.
12	Ibex Mining Co.	Colorado	Leadville	Mainly siliceous ore.
13	Kennedy Mining & Milling Co.	California	Jackson	Dry and siliceous ore.
14	Smuggler Union Mining Co.	Colorado	Upper San Miguel	Do.
15	Carson Hill Gold Mines	California	Mother Lode	Do.
16	Jib Consolidated Mining Co.	Montana	Cataract	Do.
17	Nevada Consolidated Copper Co.	Nevada	Robinson	Copper ore.
18	Argonaut Mining Co.	California	Jackson	Dry and siliceous ore.
19	United Eastern Mining Co.	Arizona	Oatman	Do.
20	Tonopah Extension Mining Co.	Nevada	Tonopah	Do.
21	Tomboy Gold Mines Co.	Colorado	Upper San Miguel	Do.
22	Sixteen to One Mines Co.	California	Allegheny	Do.
23	Calumet & Arizona Mining Co.	Arizona	Warren	Copper ore.
24	Phelps Dodge Corporation (Copper Queen).	do.	do.	Do.
25	Elkoro Mines Co.	Nevada	Jarbidge	Dry and siliceous ore.

Besides the output of gold by these large operators, $20,582,000 came from about 3,100 placer and deep mines, not including Philippine Islands, many of which produced between $100,000 and $300,000 each. Hundreds of mines, especially placer properties in California, Oregon, Idaho, Alaska, Arizona, and the Appalachian States, produced very small quantities of gold, and the average value of output of the smaller mines was about $6,700.

The Benguet Consolidated Mining Co., Philippine Islands, according to its printed report, produced about $1,200,000 in gold in 1924 (see p. 521). Only about 10 companies in the United States exceeded that output.

The largest output of silver was that of the mines operated by the Anaconda Copper Mining Co., followed by the Tintic Standard Mining Co. Of the mines enumerated in the subjoined list, seven recovered silver from dry and siliceous ore, three from lead ore, four from copper ore, four from copper ore and lead-zinc ore, three from siliceous and lead or lead-zinc ore, two from lead and lead-zinc ore, one from lead-zinc ore, and one from copper ore and siliceous ore. The California Rand mine, in California, and the Presidio mine, in Texas, were the largest producers of silver from ore that contained no appreciable quantity of any other metal. The output of the 25 properties listed was 40,417,400 ounces, or 63 per cent of the total. Seven of the largest producers were in Utah, five in Nevada, three each in Montana and Idaho, four in Arizona, and one each in California, Colorado, and Texas. None of the 25 companies produced less than 570,000 ounces in 1924.

Larger producers of silver in the United States in 1924, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
2	Tintic Standard Mining Co	Utah	Tintic	Lead and siliceous ore.
3	Tonopah Extension Mining Co	Nevada	Tonopah	Dry and siliceous ore.
4	Chief Consolidated Mining Co	Utah	Tintic	Lead and siliceous ore and lead-zinc ore.
5	Silver King Coalition Mining Co.	do	Uintah	Lead ore.
6	California Rand Silver (Inc.)	California	Randsburg	Dry and siliceous ore.
7	Butte & Superior Mining Co	Montana	Summit Valley	Copper ore and lead-zinc ore.
8	United Verde Copper Co	Arizona	Verde	Copper and siliceous ore.
9	Park Utah Mining Co	Utah	Blue Ledge	Siliceous and lead-zinc ore.
10	Comstock Merger Mines Co	Nevada	Comstock	Dry and siliceous ore.
11	Federal Mining & Smelting Co	Idaho	Hunter and Warm Springs.	Lead ore and lead-zinc ore.
12	Hercules Mining Co	do	Lelande	Lead ore.
13	Hecla Mining Co	do	do	Do.
14	Calumet & Arizona Mining Co	Arizona	Warren	Copper ore.
15	Tonopah Belmont Development Co.	Nevada	Tonopah	Dry and siliceous ore.
16	West End Consolidated Mining Co.	do	do	Do.
17	Phelps Dodge Corporation	Arizona	Warren	Copper ore.
18	Elm Orlu Mining Co	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
19	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead and lead-zinc and copper ore.
20	Utah Copper Co	do	do	Copper ore.
21	Presidio Mining Co	Texas	Shafter	Siliceous silver ore.
22	Park City Mining & Smelting Co.	Utah	Snake Creek	Lead and lead-zinc ore.
23	Sunnyside Mining & Milling Co.	Colorado	Eureka	Lead-zinc ore.
24	Magma Copper Co	Arizona	Pioneer	Copper ore.
25	Tonopah Mining Co	Nevada	Tonopah	Dry and siliceous ore.

MINE PRODUCTION OF GOLD AND SILVER, BY STATES

ALASKA

Gold.—The yield from siliceous ore increased from $2,341,596 in 1923 to $2,705,138 in 1924, and that from copper ore decreased from $33,633 to $13,341; the placer output decreased from $3,608,500 to $3,564,000. Twenty-seven dredges produced $1,563,361 of the placer gold, which was $285,235 less than the dredge output in 1923.

The 3,127,876 tons of siliceous ore treated in 1924 yielded an average of $0.88 in gold and silver to the ton, and the 761,779 tons of copper ore contained $0.52 in gold and silver to the ton.

About 43 per cent of the total output of gold in Alaska in 1924 came from gold lode mines, against 40 per cent in 1923. Dredges handled 4,342,667 cubic yards of auriferous gravel and made an average recovery of 36 cents a cubic yard, against 40 cents in 1923. The estimated total recovery of gold by dredging for the period 1903–1924 is $28,287,162.

Silver.—The mine production of silver in Alaska in 1924 was 669,641 fine ounces, against 814,649 ounces in 1923. Copper ore yielded 572,078 ounces, siliceous ore 73,990 ounces, placers 22,279 ounces, and copper-lead ore 1,294 ounces.

ARIZONA

Gold.—Of the mine production of gold in Arizona in 1924, placers contributed only $3,139. The deep mines produced $4,875,326, of which 43 per cent came from dry and siliceous ore chiefly from Mohave, Yavapai, and Cochise Counties, and 54 per cent was contained in copper ore chiefly from Cochise and Yavapai Counties. Mohave County had a gold output of $1,623,028, Cochise County $1,324,227, and Yavapai County $1,239,157. The gold recovered from ore and tailings treated at gold and silver mills represented 35 per cent of the total deep-mine output, against 48 per cent in 1923, and crude ore shipped to smelters contained 51 per cent. The crude copper ore mined and smelted directly (without previous concentration) yielded an average of about 77 cents in gold a ton.

Silver.—Of the mine production of silver in Arizona, 5,101,837 ounces came from copper ore, 912,741 ounces from lead ore, 610,213 ounces from dry and siliceous ore, and 24,458 ounces from copper-lead ore. Cochise County produced 2,381,117 ounces in 1924, of which 1,391,049 ounces came from copper ore and 341,231 ounces from siliceous ore; and Yavapai County produced 2,269,788 ounces, mainly from copper ore. Bullion recovered from gold and silver ores, almost all by cyanidation, contained 49,552 ounces of silver, concentrates 1,313,711 ounces, and crude ore shipped to smelters 5,281,360 ounces.

CALIFORNIA

Gold.—In 1924 the deep mines of California produced $8,561,803 in gold (an increase of $1,705,373), of which gold-quartz ore yielded 93 per cent, and the placers $4,588,372 (a decrease of $1,934,211). Of the placer production, $4,305,521 was recovered by dredging. The total dredge production from 1896 to the end of 1924 has been $140,370,455, and the production by dredges in 1924 was equal to 33 per cent of the total for the year. The six Yuba County dredges made the largest output, the value being $1,984,169, a decrease of $1,155,343. Six dredges in Sacramento County made an output of $1,145,075, a decrease of $178,240. In Butte County, including Oroville and other districts, four dredges produced $413,691, or $22,555 more than in 1923. Dredges were also operated in Calaveras, Placer, Shasta, Stanislaus, and Trinity Counties.

Four of the 30 counties reporting mine production of gold had a yield of more than $1,000,000 each in 1924. Of these Yuba and Sacramento Counties obtained most of their gold by dredging, Amador County is on the Mother Lode, and Nevada County produced gold mainly from siliceous ore of the Grass Valley district. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose output is mainly gold milling ore, produced $2,653,236 in gold from mill bullion and $662,690 from concentrates made from gold ore in 1924, against $2,391,203 from mill bullion and $538,830 from concentrates in 1923.

Silver.—Of the mine production of silver in California in 1924, siliceous ore yielded 2,451,552 ounces, copper ore 876,293 ounces, lead ore 188,098 ounces, zinc ore 22,500 ounces, and placers 16,690 ounces. The only counties producing more than 100,000 ounces of silver in 1924 were Inyo, Plumas, San Bernardino, and Shasta. Seventy-three per cent of the silver was recovered from ore sent to concentrating plants.

COLORADO

Gold.—The total mine production of gold in Colorado in 1924 showed a large increase from 1923 but was $10,560,705 less than in 1916. The Cripple Creek district, with an increase of $894,897, produced $4,941,905 in gold, or 57.5 per cent of the State output.

The San Juan region, in Dolores, La Plata, Ouray, San Juan, and San Miguel Counties, produced $2,075,898; and Lake County produced $980,154, an increase of $708,650. Siliceous and dry ores, forming 71 per cent of all the ore sold or treated, yielded 89 per cent of the total output of gold; nearly 5 per cent came from lead-zinc ore, 5 per cent from placers, and the remainder from ore of other classes. The gold recovered by amalgamation from 685,191 tons of ore amounted to 120,686 fine ounces, and that recovered by cyanidation to 156,665 fine ounces.

The placer production in 1924 was 20,245.23 ounces, an increase of 2,615.98 ounces. Dredges in Summit, Park, and Lake Counties produced 98 per cent of the placer gold.

Silver.—Lake County, mainly Leadville, produced 519,460 ounces of silver, a decrease of 136,378 ounces. San Miguel County produced 994,139 ounces, a decrease of 612,205 ounces. Eagle County produced 210,497 ounces, San Juan County 689,656 ounces, and Mineral County 239,149 ounces. Siliceous and dry ores yielded 61 per cent of the silver recovered, and lead-zinc ore 26 per cent.

IDAHO

Gold.—The total production of gold in Idaho from the discovery of placer gold in 1863 to the end of 1924 is estimated by C. N. Gerry at $135,183,699.

Shoshone County produced 32 per cent and Elmore County 33 per cent of the total output in 1924. The lode mines produced $198,402 in gold and the placers $358,121, of which $340,462 was won by dredging. The total output of gold recovered by dredges from 1897 to the end of 1924 has been $5,408,749. Of the total gold in 1924, 64 per cent came from placers, 22 per cent from siliceous ore, 9 per cent from copper ore, and the remainder from lead, lead-zinc, and copper-lead ores.

Silver.—The total mine production of silver in Idaho for the period 1863 to 1924, inclusive, amounts to 274,413,354 fine ounces.

Shoshone County produced 86 per cent of the total silver in 1924 against 80 per cent in 1923. Lead ore contained 74.6 per cent of the output, lead-zinc ore 16.4 per cent, and copper ore 6.5 per cent. Crude ore shipped, which averaged 19.01 ounces of silver to the ton, supplied 17 per cent of the silver, and concentrates, which averaged 24.27 ounces of silver to the ton, contained 82 per cent.

MICHIGAN

The copper mines of Michigan produced silver mainly from the electrolytic treatment of about 3,446,556 pounds of copper.

MISSOURI, OKLAHOMA, ILLINOIS, AND KENTUCKY

The lead and zinc mines of the Central States produce no gold and only a small quantity of silver. Nearly all the silver is a by-product from the refining of lead from concentrates of lead ores mined in southeastern Missouri. The total yield of silver from Missouri in 1924 was derived from lead recovered from 90,000 tons of galena concentrates produced in southeastern Missouri. Lead concentrates from the Joplin region contain about one-tenth of an ounce of silver a ton.

The lead-zinc-fluorspar deposits of the Kentucky-Illinois field carry silver, and the average silver recovery from lead concentrates from Illinois in 1924 was 5.3 ounces to the ton. No silver ore was shipped from the Criswell mine, near Byars, McClain County, Okla., in 1924.

MONTANA

Gold.—The placer output of gold in Montana was $27,361, a decrease of $13,418. Madison County had the largest placer output, $6,354, nearly all of which was recovered in Alder Gulch. Jefferson County produced $694,449, mostly from gold ore, and Silver Bow County $731,607, chiefly from copper-silver ores and lead-zinc ores. At amalgamation and cyanidation plants $243,712 in gold was recovered, an average of $2.48 per ton of ore and tailings treated. Ore treated at concentration mills yielded concentrates containing $1,482,476 or 95 cents a ton, and crude ore shipped to smelters contained $265,998 in gold, an average of $1.78 a ton.

Silver.—Copper ore from Montana mines yielded 7,845,180 ounces of silver in 1924 (an average of 2.28 ounces a ton), of which Silver Bow County (Butte) supplied 7,842,876 ounces. The lead-zinc ore yielded 3,211,443 ounces. The dry and siliceous ores yielded 947,083 ounces of which Silver Bow County supplied 424,529 ounces from silver ore.

NEVADA

Gold.—The mine production of gold in the Comstock district of Nevada in 1924 was $1,108,743, against $956,818 in 1923. Nye County produced $1,470,855, of which $1,161,993 came from Tonopah where there was an increase of $54,664. Siliceous ore yielded 181,627.55 fine ounces and copper ore 32,314.93 ounces.

Silver.—Nye County (almost wholly the Tonopah district) again led in the production of silver, with 5,029,825 ounces, or 202,608 ounces less than in 1923. All but 1,408,520 ounces of the State's output came from dry and siliceous ores, and 78 per cent was recovered by cyanidation. Lead ores yielded 1,093,429 ounces.

NEW MEXICO

Gold.—The mine production of gold in New Mexico in 1924 came mainly from Catron County, which produced $230,960; Hidalgo County, $192,224; and Grant County, $75,472.

Copper ore contained 12,626 ounces of gold, against 13,851 ounces in 1923, and dry and siliceous ore contained 11,873 ounces. The output from lead ore was 114 ounces, from copper-lead ore 15 ounces, and the placer output was 176 ounces.

Silver.—Catron County produced 618,094 fine ounces of silver, all from siliceous ore, and Hidalgo County produced 116,006 fine ounces, mainly from copper ore. Siliceous ore yielded 626,072 ounces, copper ore 131,743 ounces, and lead and copper-lead ores only 37,228 ounces. The output of silver from Grant County decreased from 94,392 ounces in 1923 to 43,064 ounces in 1924.

OREGON

Gold.—The placer mines in Oregon produced $325,582 in gold in 1924, or $48,812 more than in 1923. Of the output from deep mines, which produced $226,260—an increase of $5,022—82 per cent was obtained from siliceous ore. Two dredges in Baker County and one dredge in Grant County produced $291,557, and a few drift and hydraulic mines and surface placers in Baker, Coos, Crook, Curry, Douglas, Grant, Jackson, Josephine, Linn, Malheur, and Wheeler Counties produced the remainder of the placer gold. Baker and Grant Counties produced $324,000 and $171,000 in gold, respectively.

Silver.—Of the total production of silver, 23,130 ounces came from siliceous ore, 12,694 ounces from copper ore, and 2,279 ounces from placer bullion.

SOUTH DAKOTA

The total value of gold produced in South Dakota from 1876 to the end of 1924 was $249,270,351, and the total output of silver for the same period was 7,214,609 fine ounces.

Gold.—The mine production of gold in South Dakota in 1924 was derived wholly from siliceous milling ore of low grade. About 69 per cent of the output was recovered by amalgamation, and the remainder by cyanidation. The Homestake mines and mills produced $6,126,350 in gold bullion from 1,670,300 tons of ore treated.

Silver. The mine output of silver, 86,548 ounces, was derived from refining the gold bullion produced.

SOUTHERN APPALACHIAN AND EASTERN STATES

Gold.—The total production from 1799 to the end of 1924 in the southern Appalachian States, as shown from data compiled by the Bureau of the Mint, the United States Geological Survey, and the Bureau of Mines, has been $51,076,216. The data credit Alabama with $766,746, Georgia with $17,830,374, Maryland with $71,405, North Carolina with $23,639,901, South Carolina with $5,182,305, Tennessee with $287,337, and Virginia with $3,298,148.

The mine production of gold in the southern Appalachian States in 1924 was $12,111, against $8,673 in 1923. Tennessee led and North Carolina was next. The gold produced in Tennessee (328.95 ounces) was derived from copper ore of the Ducktown district. The gold produced in Pennsylvania (214.01 ounces) was derived from copper concentrates from pyritiferous magnetite ore. Siliceous ore, nearly all from North Carolina, yielded 247.58 ounces. The production of gold from placers amounted to 9.34 ounces.

Silver.—Copper ore in Tennessee yielded 94,779 ounces of silver in 1924; copper concentrates from pyritiferous magnetite ore in Pennsylvania yielded 2,810 ounces; and siliceous ore and placer bullion yielded only 39 ounces.

TEXAS

The total output of gold from Texas mines from 1885 to the end of 1924 is given by Charles W. Henderson as $44,409, and the output of silver for the same period has been 17,988,043 ounces.

Gold.—The small yield of gold has been mainly a by-product.

Silver.—The greater part of the silver produced in Texas in 1924 (720,739 ounces) continued to come from the Presidio mine.

UTAH

Gold.—The total output of gold in Utah from 1864 to the end of 1924 is given by V. C. Heikes as $110,413,925.

In 1924 the Bingham district, in Salt Lake County, produced $2,116,643, and the Tintic district, in Juab and Utah Counties, $591,405. Placer gold amounted to $232, and the output recovered by cyanidation and amalgamation was about $889. Nearly 57 per cent of the Utah gold was derived from copper ore, mined mainly in Salt Lake County; lead and lead-zinc ores yielded 24.5 per cent; siliceous ore 18.5 per cent; and placers and copper-lead ore a few ounces.

Silver.—The total output of silver in Utah from 1864 to the end of 1924 has been 470,147,321 fine ounces, according to V. C. Heikes. In 1924 the largest production was made in Juab County, credited with 4,285,995 ounces, mainly from lead ore and silver ore, against 5,788,396 ounces, mainly from lead ore, in 1923. Utah County had 3,995,901 ounces, mostly from lead and siliceous ores, against 3,466,310 ounces in 1923. Of the Salt Lake County output of 2,919,210 ounces, the Bingham district produced 2,494,698 ounces. The Tintic district, in Juab and Utah Counties, produced 8,254,517 ounces, nearly all from lead and siliceous ores; and the Park City region, in Summit and Wasatch Counties, produced 5,613,540 ounces, all from lead, siliceous, and lead-zinc ores. Altogether in 1924 the lead ore of Utah yielded 9,936,956 ounces of silver, copper ore 887,541 ounces, lead-zinc ore 1,679,588 ounces, and dry and siliceous ore 4,749,144 ounces. The crude ore smelted in 1924 contained 12,310,703 ounces, and concentrates 3,724,896 ounces.

WASHINGTON

The total production of gold in Washington from earliest mining to the end of 1924 is given by C. N. Gerry as $29,094,207, and the total production of silver as 8,611,020 fine ounces.

Gold.—Of the mine production of gold in Washington in 1924, 93 per cent was derived from ore shipped directly to smelters and 6 per cent from gold and silver milling plants; siliceous ore supplied 98.18 per cent, and copper ore and lead ore together less than 2 per cent. Ferry County alone produced $280,751 in 1924 against $276,605 in 1923. Virtually all the gold produced in Ferry County in 1924 came from mines in the Republic district. Whatcom County produced $18,745 in gold.

Silver.—Of the mine production of silver Ferry County produced 70,347 ounces, mainly from siliceous ore; Stevens County 132,931 ounces, from copper ore and lead ore.

WYOMING

The total production of gold in Wyoming from 1867 to the end of 1924 has been $1,237,624, and the output of silver for the same period 70,113 ounces.

None of the mines in Wyoming reported any output of gold or silver 1924.

PHILIPPINE ISLANDS

Gold.—The output of gold in the Philippine Islands from 1907 to 1924, inclusive, has been $17,813,424. The distribution by years has been as follows:

1912	$570,212	1919	$1,309,722
1913	868,362	1920	1,276,561
1914	1,371,514	1921	1,313,096
1915	1,320,900	1922	1,526,400
1916	1,514,200	1923	1,686,327
1917	1,408,161	1924	1,651,796
1918	1,290,000		

The yield of gold in 1924 from three deep mines producing siliceous ore was $1,567,546. The gold derived from placers amounted to $84,250.

The milling plant of the Benguet Consolidated Mining Co., in the Province of Luzon, the largest producer of gold in the Philippine Islands, is described in the Mining and Scientific Press of December 4 and 11, 1920. There was not much activity in 1924 except at the Benguet mine.

The annual report of the Benguet Consolidated Mining Co. for 1924 states that 89,621 tons of ore (14,462 tons more than in 1923) was cyanided, yielding $13.58 a ton in gold and silver. The bullion recovered was $1,216,640. The ore reserves were estimated to be 206,273 tons at the end of 1924. The capacity of the mill is 200 tons a day, the net profit from operations in 1924 was $533,730, and the dividends paid amounted to 50 centavos a share on a capital stock of 2,000,000 shares.[2]

Silver.—The mine production of silver in the Philippine Islands in 1924 was recovered entirely from gold bullion refined, as no attempt was made to develop the known deposits of silver ore. The quantity of silver derived from bullion in 1924 was 43,127 fine ounces.

NUMBER OF PRODUCING MINES

The following table indicates the number of mines that produced gold and silver in 1924. The placers are those in which the gold and the silver that is in natural alloy with the gold and, in a few placers, with platinum also are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The deep mines are those producing gold and silver (from ore as distinguished from gravel) mainly from underground workings, including those whose ore is valuable chiefly for copper, lead, or zinc but which contribute precious metals as by-products. In addition to producing mines here enumerated, many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

[2] Eng. and Min. Jour.-Press, May 23, 1925.

The enumeration of placer mines is less satisfactory than that of deep mines, because some of the operations are only temporary and individually small and because much of the production is made by transitory miners not regularly working placer ground. The unit so far as possible is, as for deep mines, not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold and silver in 1924 [a]

State or Territory	Placer	Deep	Total
Alaska	540	24	564
Arizona	9	266	275
California	266	267	533
Colorado	18	340	358
Georgia	1	4	5
Idaho	79	141	220
Illinois [b]	----------	3	3
Michigan [b]	----------	2	2
Missouri [b]	----------	2	2
Montana	86	302	388
Nevada	36	348	384
New Mexico	10	86	96
North Carolina	1	1	2
Oregon	43	71	114
Pennsylvania [b]	----------	1	1
South Dakota	----------	4	4
Tennessee [b]	----------	2	2
Texas	----------	1	1
Utah	2	136	138
Virginia [b]	----------	1	1
Washington	4	30	34
	1,095	2,032	3,127

[a] Philippine Islands and Porto Rico excluded.
[b] Number of mines contributing to production of gold and silver.

Number of mines in the United States producing gold and silver, 1914–1924

Year	Placer	Deep	Total	Year	Placer	Deep	Total
1914	1,815	3,158	4,973	1921	1,357	1,967	3,324
1915	1,720	3,597	5,317	1922	1,359	2,206	3,565
1916	1,530	3,765	5,295	1923	1,295	2,188	3,483
1917	1,552	3,811	5,363	1924	1,095	2,032	3,127
1918	1,414	3,287	4,701				
1919	1,105	2,460	3,565	Average	1,387	2,800	4,187
1920	1,012	2,331	3,343				

The total number of properties operated in 1924 was 1,060 less than the average for the last 11 years. The number of placer properties worked showed a decrease of 200 compared with 1923, and was 1,221 less than the number operated in 1906. This is a natural result of the exhaustion of the rich gravel and of the acquisition of large areas of placer ground by dredge companies. The number of deep mines operated was 156 less than in 1923 and 768 less than the average for 11 years, and fewer deep mines were operated than in any other year since 1906, except 1921.

ORE PRODUCTION, CLASSIFICATION, AND AVERAGE VALUE

The best index of deep mining is found in the quantity, metallic content, and value of ore mined, rather than in the number of mines or of operators. In the next table are given the production of ore from mines producing gold and silver and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. The complex nature of western ores especially and the gradations from one well-recognized class to another render essential a fixed terminology. The dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious metal-bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made. The total number of silver mines and the total production of true silver ore are both comparatively small. The copper ores include those containing 2.5 per cent or more of copper, or less than this percentage in the great disseminated copper deposits of the West and in the Lake Superior ores; in general, the lead ores are those containing 4.5 per cent or more of lead and the zinc ores are those containing 25 per cent or more of zinc, both irrespective of their precious-metal content; but ores of lower grades in lead and especially in zinc are treated profitably in many districts, and of course they are then classified as lead or zinc ores, as the case may be. The mixed ores are combinations of those enumerated.

The lead, zinc, and lead-zinc ores in many districts in the Eastern and Central States carry no appreciable quantity of gold or silver, and such ores are excluded from this report.

The total quantity of ore sold or treated from which gold or silver was produced increased more than 20,350,000 tons in the four years prior to 1920, decreased 23,791,863 tons in 1921, and increased 13,609,082 tons in 1922, 19,918,985 tons in 1923, and 3,287,283 tons in 1924, when it amounted to 58,382,678 tons. In 1924, owing to the increased activities of the large mines, copper ore sold or treated increased 3,291,070 tons, but the total quantity of other ores decreased 4,787 tons.

Arizona led in quantity of ore by more than 6,000,000 tons, as its output was mainly copper ore. Utah was second, owing to its copper, lead, and siliceous ores. Nevada was third and Montana fourth, each with an output of which about 75 per cent was copper ore. Alaska, New Mexico, California, Idaho, South Dakota, and Colorado, followed in order of output. The bulk of the ore from Alaska, South Dakota, California, and Colorado was low-grade siliceous ore, and that from Idaho was mainly lead ore. The larger part of the output of ore from Nevada was copper ore, and the production of siliceous ore was much less than in 1923. All the ore from Michigan was low-grade copper ore, and 93 per cent of the ore treated from New Mexico was copper ore.

Ore produced in the United States and average extraction value of gold and silver per ton in 1924 [a]

State	Dry and siliceous ores		Copper ore		Lead ore	
	Short tons	Average value	Short tons	Average value	Short tons	Average value
Alaska	3,127,876	$0.88	761,779	$0.52		
Arizona	239,755	10.38	19,460,836	.31	114,670	$6.49
California	1,075,858	9.06	917,806	1.12	16,536	8.62
Colorado	1,074,876	8.34	1,803	33.66	67,979	4.83
Georgia	50	11.60				
Idaho	19,260	7.87	37,634	10.31	1,254,212	3.12
Michigan [b]			[b] 143,600	.61		
Montana	207,487	9.35	3,437,931	1.68	78,656	2.84
Nevada	1,066,479	8.55	3,505,301	.21	81,202	9.53
New Mexico	76,176	8.73	2,832,901	.12	8,017	3.07
North Carolina	2,000	2.22				
Oregon	30,011	6.68	14,831	3.36		
Pennsylvania [c]			[c] 684,700	[c].43		
South Dakota	1,674,720	3.69				
Tennessee [d]			714,975	.10		
Texas	84,744	5.70				
Utah	282,226	13.26	12,357,366	.19	729,219	9.82
Virginia	20	5.90				
Washington	17,575	19.97	15,916	2.01	8,111	8.51
	8,979,113	5.21	44,887,379	.39	2,358,602	5.71
Percentage	15.38		76.88		4.04	
1923:						
Total	9,121,719	5.91	41,596,309	.42	2,287,494	7.56
Percentage	16.56		75.50		4.15	

State	Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	
Alaska			29	$141.79			3,889,684
Arizona			5,244	5.83			19,820,505
California	9,000	$2.13					2,019,200
Colorado	18,946	.09	425	48.72	350,153	$2.79	1,514,182
Georgia							50
Idaho			4,462	21.44	396,420	2.18	1,711,988
Michigan [b]							143,600
Montana			209,185	3.28	719,223	3.17	4,652,482
Nevada	41		3	399.33	46,307	3.30	4,699,333
New Mexico	115,045		507	5.90	8,006		3,040,652
North Carolina							2,000
Oregon							44,842
Pennsylvania [c]							684,700
South Dakota							1,674,720
Tennessee [d]							714,975
Texas							84,744
Utah	45		19	18.21	271,743	5.02	13,640,618
Virginia							20
Washington	2,781	.02					44,383
	145,858	.14	219,874	3.83	1,791,852	3.14	58,382,678
Percentage	0.25		0.38		3.07		100.00
1923:							
Total	723,994	2.55	162,181	7.30	1,203,698	3.39	55,095,395
Percentage	1.31		0.29		2.19		100.00

[a] Illinois, Missouri, Philippine Islands, and Porto Rico not included; quantity of crude ore containing gold and silver not known.

[b] Includes only copper ore that yielded silver.

[c] Ore is pyritiferous magnetite yielding 14,544 tons of low-grade copper concentrates; value given is per ton of concentrate.

[d] Zinc and lead ores yielded no gold or silver.

The value of the gold and silver recovered from sources other than siliceous ore and placer bullion in the United States (Philippine Islands and Porto Rico excluded) in 1924 was $37,318,691. Reports show that this gold and silver was derived from about 49,403,600 tons of base ores, which yielded an average of 76 cents a ton. Of this average only about 16 cents represents gold.

The average recovery from siliceous ore in 1924 was $3.69 in gold a ton, so that a ton of siliceous ore yielded 23 times as much gold as the average derived from a ton of ore of all other classes combined, and 26 times as much as was derived from a ton of copper ore which constituted 77 per cent of the total quantity of ores containing gold and silver in 1924. For this reason it seems hopeless to expect any large increase in the production of gold in the United States by reason of increase in the quantity of base ores mined, even though the quantity should be doubled.

In 1924 the lead ore of Utah showed an average recovery in gold and silver of $9.82 a ton, and that of Idaho, which produced over half of the total output of lead ore containing gold, only $3.12 a ton. In the output of ore considered as producing gold and silver, the proportion of dry and siliceous ore decreased slightly, being 15.4 per cent, compared with 16.6 per cent in 1923, and the proportion of lead ore was nearly the same in 1924 and 1923, whereas that of copper ore increased from 75.5 to 76.9 per cent. The proportion of other classes of ore, which together made up only 3.7 per cent of the total, showed increases except zinc ore. The average value per ton in gold and silver of each class of ore decreased considerably in 1924, as was natural with a lower price of silver.

During the period 1906–1924 the peak of production of dry and siliceous ores was reached in 1916, though the proportion of such ores to the total was largest in 1906. The extraction value of these ores varies considerably in different years, depending to a large degree on the quantity of low-grade ores milled in Alaska and South Dakota, which aggregated more than half of the siliceous ores treated in 1924. The decided decrease in the average extraction value of gold and silver in copper ore—from $1.55 a ton in 1906 to 39 cents in 1924—was caused by the low gold and silver content in the greatly increased quantity of copper ore derived from mines in Arizona, New Mexico, Nevada, and Utah. As silver predominates over gold in most of the lead ore, the average extraction value shows a wider range than the quantity of ore. Zinc ore formed less than 1 per cent of the total ore given in the following table, and its average extraction value in precious metals shows a considerable range. The copper-lead and copper-lead-zinc ores have been negligible in quantity, though increasing since 1921, but they show a higher average extraction value than ore of any other class.

Ore produced in the United States and average extraction value of gold and silver per ton, 1914–1924 [a]

Year	Dry and siliceous ores		Copper ore		Lead ore	
	Short tons	Average value	Short tons	Average value	Short tons	Average value
1914	10,966,666	$6.95	27,653,352	$0.49	2,307,550	$5.29
1915	12,687,126	6.26	32,973,166	.51	2,429,546	4.86
1916	12,921,268	5.73	47,478,127	.51	2,373,579	5.95
1917	12,166,026	5.56	49,049,181	.49	2,494,077	6.88
1918	9,702,240	6.58	53,409,729	.50	2,356,585	8.24
1919	9,302,229	6.25	29,919,369	.61	1,815,243	9.33
1920	8,590,139	6.26	32,447,410	.52	2,368,619	8.26
1921	8,436,214	6.65	10,930,888	.54	2,053,575	7.89
1922	8,728,222	6.98	23,356,128	.56	2,123,673	8.24
1923	9,121,719	5.91	41,596,309	.42	2,287,494	7.56
1924	8,979,113	5.21	44,887,379	.39	2,358,602	5.71

Year	Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	
1914	622,811	$0.19	11,577	$12.87	1,488,747	$2.90	43,050,703
1915	512,634	1.32	10,951	15.55	1,900,029	2.06	50,513,452
1916	833,345	1.21	79,992	5.54	2,702,091	2.31	66,388,402
1917	641,755	.90	31,675	14.58	2,793,613	2.82	67,176,327
1918	210,298	.76	15,698	16.19	2,352,350	3.47	68,046,900
1919	88,654	.52	17,632	15.97	1,365,945	4.91	42,509,072
1920	482,229	3.00	26,890	30.01	1,443,904	4.10	45,359,191
1921	10,116	.76	14,248	31.76	122,287	16.96	21,567,328
1922	471,172	3.68	52,370	13.76	444,845	7.89	35,176,410
1923	723,994	2.55	162,181	7.30	1,203,698	3.39	55,095,395
1924	145,858	.14	219,874	3.83	1,791,852	3.14	58,382,678

[a] Illinois, Missouri, Philippine Islands, and Porto Rico excluded. Crude ore containing gold and silver not known.

MINE PRODUCTION OF GOLD, BY SOURCES

As shown in the following table, 84 per cent of the domestic output of gold in 1924 was obtained from dry and siliceous ores—normally gold quartz and gold-silver quartzose ores—and from placers. The total contribution of gold derived from the great copper, lead, and zinc mines of the country is relatively small, notwithstanding their recent enormous development and production of ore, but this contribution in 1924 was slightly greater than in 1923, owing to the larger quantities of base ores, especially copper ores, treated.

Mine production of gold in the United States in 1924, by States, in fine ounces [a]

State or Territory	Placers	Dry and siliceous ores	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alaska	172,408.50	130,861.05	645.37			156.98		304,071.90
Arizona	151.85	100,630.06	128,121.07	6,407.26		685.50		235,995.74
California	221,962.51	392,052.34	21,129.50	795.37	200.00			636,139.72
Colorado	20,245.23	369,516.06	2,136.19	3,586.75	26.79	303.50	19,877.46	415,691.98
Georgia	3.77	27.91						31.68
Idaho	17,324.10	5,808.43	2,407.47	1,061.00		12.35	308.45	26,921.80
Montana	1,323.59	63,174.26	24,926.12	1,486.37		819.92	6,123.90	97,854.16
Nevada	1,323.97	181,627.55	32,314.93	1,995.82		.05	700.24	217,962.56
New Mexico	176.04	11,872.65	12,625.60	114.04		15.23		24,803.56
North Carolina	5.57	214.06						219.63
Oregon	15,750.04	8,943.57	2,001.75					26,695.36
Pennsylvania [b]			214.01					214.01
South Dakota		295,930.24						295,930.24
Tennessee			328.95					328.95
Utah	11.22	27,098.75	83,444.56	24,380.08		1.76	11,550.48	146,486.85
Virginia		5.61						5.61
Washington	33.77	14,706.15	117.70	120.10				14,977.72
	450,720.16	1,602,468.69	310,413.22	39,946.79	226.79	1,995.29	38,560.53	2,444,331.47
Value	$9,317,213	$33,125,968	$6,416,811	$825,773	$4,688	$41,246	$797,117	$50,528,816
Percentage	18.44	65.56	12.70	1.63	.01	.08	1.58	100.00
1923: Total	551,928.99	1,510,097.69	271,689.52	38,109.47	3,320.71	3,800.74	25,965.43	2,404,912.55
Value	$11,409,385	$31,216,490	$5,616,321	$787,793	$68,645	$78,568	$536,753	$49,713,955
Percentage	22.95	62.79	11.30	1.58	0.14	0.16	1.08	100.00

[a] Philippine Islands and Porto Rico not included. The Bureau of Science, Manila, P. I., reports that lode gold mines of the Philippine Islands produced 75,824 ounces of gold and placer mines 4,076 ounces.
[b] From pyritiferous magnetite ore.

During the period 1905–1924 dry and siliceous ores yielded 65.6 per cent of the total output of gold, placer mining 25 per cent, copper ore 6.8 per cent, and all other ores 2.6 per cent. It is evident that there can be no great increase from the miscellaneous base ores. The yield from copper ore may increase, but no probable gain will bring the output of gold from copper ore to more than $6,500,000 or $7,500,000. The yield of gold from placers in 1924 was less than half that of the average of the years 1906–1916, and though there may be spasmodic increases during the next few years, it is certain that the output from this source will decline, owing to the steady exhaustion of ground capable of being worked with dredges. Apparently any large increases in the yield of gold must come from dry and siliceous ores, which have yielded two-thirds of the output in the last 20 years. As the production from these ores has decreased about 50 per cent since 1915, as no new large bodies of ore of this class have been discovered, and as some of the low-grade siliceous ore can not be worked on account of the increased cost of mining and milling, there is apparently no reason to expect that the annual yield of gold from mines in the United States will exceed $50,000,000 to $55,000,000.

Gold produced in the United States, by sources, as reported by mines, 1914–1924, in fine ounces [a]

Year	Placers	Dry and siliceous ores	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1914	1,117,931	2,940,873	264,832	74,514	1,913	548	17,451	4,418,062
1915	1,077,432	3,212,298	343,226	84,449	4,975	2,496	29,599	4,754,475
1916	1,106,901	2,795,764	401,127	71,922	8,302	4,452	28,539	4,417,007
1917	1,026,062	2,416,985	341,117	68,464	6,085	4,474	37,022	3,900,209
1918	758,202	2,045,495	309,018	55,246	1,188	1,431	42,093	3,212,673
1919	704,377	1,780,567	186,701	41,945	86	1,043	38,563	2,753,282
1920	603,002	1,523,331	171,055	46,776	3,657	3,731	31,435	2,382,987
1921	677,435	1,548,251	52,765	61,924	76	159	4,400	2,345,010
1922	537,910	1,560,789	130,928	35,415	2,807	2,467	22,935	2,293,251
1923	551,929	1,510,098	271,690	38,109	3,321	3,801	25,965	2,404,913
1924	450,720	1,602,469	310,413	39,947	227	1,995	38,560	2,444,331

[a] Philippine Islands and Porto Rico excluded.

PLACERS

General features.—The States showing a considerable increase in placer gold in 1924 were Oregon (2,361 ounces) and Colorado (2,616 ounces). The largest decreases were in California (93,567 ounces), Idaho (6,801 ounces), Nevada (2,618 ounces), Alaska (2,153 ounces), and Montana (649 ounces).

The placer gold is derived chiefly from dredging (which yielded 74 per cent of the total in 1924), from drift mining (which is of decreasing importance in Alaska in frozen ground at no great depth but of continued importance in California in ancient buried river channels, in places at considerable depth), and from hydraulic and sluicing placers. Finally, there is a small annual output of gold from dry placers in the Southwest and also of gold and platinum from ocean-beach mining in California and Oregon.

Dredging.—The value of gold produced by dredging in the United States from the commercial beginning of the industry in 1896 to the end of 1924 has amounted, according to the best available data, to $196,765,474, of which $140,370,455 came from California, $28,287,162 from Alaska, $9,592,435 from Montana, $7,784,040 from Colorado, $5,408,749 from Idaho, $4,722,528 from Oregon, and $600,105 from other States. The production of gold from dredges in 1924 was $2,000,000 less than in 1923, though the number of dredges operated was only 3 less. Further information, especially for earlier years, is to be found in previous issues of Mineral Resources, in reports of the Director of the Mint, and in reports of geological surveys or mining officials of different States.

Gold produced in the United States by dredges, 1914–1924

Year	Dredges	California	Alaska	All other States [a]	Total
1914	120	$7,783,394	$2,350,000	$2,379,389	$12,512,783
1915	114	7,796,465	2,330,000	2,356,660	12,483,125
1916	113	7,769,227	2,679,000	2,338,487	12,786,714
1917	109	8,313,527	2,500,000	1,736,898	12,550,425
1918	93	7,431,927	1,425,000	1,485,173	10,342,100
1919	91	7,716,919	1,360,000	1,269,297	10,346,216
1920	78	6,900,366	1,129,932	1,256,158	9,286,456
1921	72	7,756,787	1,582,520	1,196,261	10,535,568
1922	71	4,999,215	1,767,753	922,300	7,689,268
1923	66	6,065,735	1,848,596	1.084,716	8,999,047
1924	63	4,305,521	1,563,361	1,044,099	6,912,981

[a] Colorado, Idaho, Montana, Oregon, New Mexico, Nevada, South Dakota, Wyoming, Washington, Alabama, Georgia, and North Carolina.

Of the output in 1924 California produced $4,305,521 from 27 dredges, Alaska $1,563,361 from 27 dredges, Colorado $412,080 from 4 dredges, Idaho $340,462 from 2 dredges, and Oregon $291,557 from 3 dredges.

DRY AND SILICEOUS ORES

The siliceous ore comprises free-milling (amalgamating) ore, as in Alaska, California, and Oregon; both amalgamating and concentrating ore, as in many States; simply concentrating ore, as in parts of Colorado and Arizona; all-sliming and cyaniding ore, as in Nevada; and finally smelting ore. Tailings both from old dumps and from present millings are largely reworked by concentration and subsequent cyanidation or smelting. Owing to the increase in the cost of labor and supplies in the last six or seven years, much of the old tailings could not be reworked at a profit. The material smelted consists mainly of concentrates and of siliceous and pyritic ores, which are also valuable as fluxes. Exact figures of relative output by methods and by States are given on page 534.

As most of the gold produced in the United States is derived from placer gravel and dry and siliceous ores, including true gold, gold-silver, and silver ores, the following table for certain States, prepared by V. C. Heikes, is of special interest:

Gold produced in six Western States, 1919–1924

Year	Number of producers	Ore mined (short tons)	Total gold, including placer production (fine ounces)	Gold ore			
				Number of producers	Short tons	Gold content (fine ounces)	
						Total	Average
Arizona:							
1919	339	13,727,403	217,997.72	34	190,069	125,188.13	0.66
1920	318	14,920,478	231,528.65	41	201,334	139,857.94	.69
1921	215	5,455,030	141,753.41	26	182,194	114,044.05	.63
1922	318	10,746,045	170,479.98	72	173,070	102,814.10	.59
1923	341	17,015,178	296,109.23	65	226,585	142,442.85	.63
1924	275	19,820.505	235,995.74	65	209,356	92,771.09	.44
Idaho:							
1919	210	1,457,395	34,502.89	31	44,537	21,989.06	.49
1920	163	1,958,401	23,490.42	17	38,534	13,708.33	.35
1921	225	1,514,447	26,399.73	29	47,174	13,710.44	.29
1922	248	1,436,884	24,255.46	36	21,580	8,734.16	.40
1923	231	1,763,520	37,124.28	47	21,953	6,247.99	.28
1924	220	1,711,988	26,921.80	39	17,886	5,646.12	.32
Montana:							
1919	457	4,183,594	107,856.32	87	130,922	56,301.56	.43
1920	457	5,241,615	89,550.11	60	98,307	38,284.51	.39
1921	445	1,324,801	71,631.91	104	96,504	41,684.11	.43
1922	393	4,385,878	80,145.62	77	161,900	42,695.72	.26
1923	382	5,743,535	85,079.43	78	217,307	48,277.86	.22
1924	388	4,652,482	97,854.16	110	154,942	57,701.18	.37
Nevada:							
1919	421	3,187,831	219,695.16	94	163,279	111,170.33	.68
1920	473	3,480,620	172,540.46	106	102,772	48,873.75	.48
1921	431	1,096,138	160,254.62	122	63,850	50,699.95	.79
1922	387	1,565,276	159,510.95	108	69,337	57,954.24	.84
1923	389	4,354,937	204,292.89	128	142,148	64,197.59	.45
1924	384	4,699,333	217,962.56	152	139,041	70,067.65	.50
Utah:							
1919	179	6,745,423	104,464.41	6	553	1,528.81	2.76
1920	164	6,800,180	97,454.15	3	19	85.00	4.47
1921	138	2,137,522	85,619.15	2	69	266.69	3.86
1922	154	5,560,034	111,110.36	4	36,624	15,924.48	.43
1923	150	12,752,998	148,824.86	9	17,903	9,333.57	.52
1924	138	13,640,618	146,486.85	8	2,129	2,268.12	1.07
Washington:							
1919	49	100,879	12,232.20	11	25,648	11,951.91	.46
1920	44	85,318	5,846.60	10	12,513	5,510.88	.44
1921	37	22,885	6,215.51	9	15,985	5,966.77	.37
1922	46	36,046	9,044.43	10	17,944	8,764.15	.49
1923	36	56,900	16,547.49	12	30,146	16,310.46	.54
1924	34	44,383	14,977.72	12	17,543	14,705.87	.84

Gold produced in six Western States, 1919–1924—Continued

Year	Gold-silver ore		Silver ore		Placers	
	Short tons	Gold (fine ounces)	Short tons	Gold (fine ounces)	Number of producers	Gold (fine ounces)
Arizona:						
1919	19,536	6,474.19	85,070	4,279.51	15	227.07
1920	1,177	236.75	78,190	9,423.34	8	220.93
1921	75	23.67	50,932	2,390.05	37	605.85
1922	2,031	1,351.19	71,185	4,249.82	33	579.58
1923	268,537	35,273.99	71,171	6,742.02	24	428.31
1924	8,291	4,857.81	22,108	3,001.16	9	151.85
Idaho:						
1919	21	15.94	3,693	257.08	72	9,227.63
1920	5	9.55	1,272	88.49	49	5,505.76
1921	54	39.14	993	76.96	92	8,784.90
1922	257	193.81	3,929	156.97	94	8,899.64
1923	311	82.91	1,795	239.24	85	24,125.05
1924	17	30.86	1,357	131.45	79	17,324.10
Montana:						
1919	118	61.58	90,646	7,926.41	62	14,097.92
1920	847	423.20	79,198	6,585.71	65	13,977.76
1921	1,401	715.66	67,001	4,978.18	97	10,988.91
1922	6,594	1,079.35	204,817	9,568.17	78	3,472.65
1923	275	394.11	124,671	6,071.84	78	1,972.68
1924	161	133.32	52,384	5,339.76	86	1,323.59
Nevada:						
1919	68,874	28,478.76	551,414	54,358.94	37	6,399.43
1920	76,863	24,216.14	619,572	62,968.62	39	7,383.91
1921	60,365	18,969.68	543,345	63,625.31	61	17,566.99
1922	44,503	10,189.16	758,043	72,362.96	42	11,602.36
1923	551,504	39,417.45	678,318	63,579.46	35	3,941.83
1924	524,248	48,099.53	403,190	63,460.37	36	1,323.97
Utah:						
1919	14,618	3,489.71	224,517	20,198.11	----------	----------
1920	24,837	10,209.30	266,164	23,053.69	3	21.91
1921	33,616	11,769.97	342,787	17,517.44	4	20.03
1922	4,145	2,178.47	373,570	20,250.67	7	103.04
1923	23,722	3,095.32	304,800	20,285.62	4	25.49
1924	39,490	11,287.00	240,607	13,543.63	2	11.22
Washington:						
1919	----------	----------	3,438	65.02	7	60.32
1920	----------	----------	583	38.94	9	71.20
1921	----------	----------	4,214	48.61	11	148.66
1922	----------	----------	6,838	66.72	13	162.44
1923	----------	----------	3,353	38.46	6	73.09
1924	----------	----------	32	.28	4	33.77

Nearly all the siliceous ore in three of the largest gold-producing States—Alaska, California, and South Dakota—yields only a small quantity of silver and is classed as gold ore. The siliceous ore from Colorado includes much silver and gold-silver ore.

Siliceous ore treated and gold recovered per ton of ore treated, 1914–1924

Year	Alaska		California		South Dakota		Colorado	
	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton
	Short tons	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*
1914	1,738,127	0.135	2,050,797	0.264	2,019,255	0.175	2,157,762	0.414
1915	3,020,607	.097	2,368,352	.272	1,889,970	.189	2,183,431	.464
1916	3,548,798	.081	2,192,078	.262	1,870,721	.193	2,057,452	.412
1917	3,414,664	.065	2,018,003	.246	1,867,859	.191	1,996,590	.347
1918	2,095,577	.080	1,538,960	.261	1,781,569	.178	1,760,222	.322
1919	3,262,573	.068	1,212,142	.339	1,330,349	.177	1,667,076	.258
1920	3,413,736	.063	788,136	.439	1,356,098	.167	1,224,081	.257
1921	2,894,813	.064	902,566	.402	1,725,669	.185	1,230,172	.250
1922	2,513,455	.058	1,052,148	.414	1,751,454	.180	1,296,501	.221
1923	2,502,901	.045	925,659	.347	1,665,439	.186	1,166,470	.243
1924	3,127,876	.042	1,075,858	.364	1,674,720	.177	1,074,876	.344

The quantity of siliceous ore treated in South Dakota in 1924 increased, but the recovery of gold per ton was slightly less; the siliceous ore in California increased about 150,000 tons and the gold recovery per ton was more than in 1923 but smaller than for other recent years. The quantity of siliceous ore treated in Alaska increased about 625,000 tons. The gold recovery in Colorado per ton was the largest since 1917.

COPPER ORE

The gold obtained as a by-product in the treatment of copper ore showed an increase in 1924 of about $800,000. This source of gold contributed a larger percentage of the total gold yield than in 1923. The largest producer of gold from copper ore was Arizona, followed by Utah, Nevada, Montana, California, and New Mexico.

LEAD ORE

Eighty-six per cent of the gold in lead ores sold or treated in 1924 came from Utah, Arizona, and Colorado. The total production showed an increase compared with the output in 1923.

LEAD-ZINC, ZINC, AND MIXED ORES

The production of gold from zinc, lead-zinc, copper-lead, and copper-lead-zinc ores in 1924 was 7,696 ounces more than in 1923. Colorado, Utah, and Montana produced nearly all the gold from lead-zinc ore and California produced most of the gold from zinc ore. Montana, Arizona, and Colorado contributed nearly all the gold from copper-lead ore.

MINE PRODUCTION OF SILVER, BY SOURCES

The mine production of silver in 1924 from the three chief sources—dry and siliceous ore, copper ore, and lead ore—was 86.75 per cent of the total, against 88.78 per cent in 1923. Lead-zinc ore yielded 11.27 per cent and combined yield of silver from placer bullion, zinc ore, and copper-lead and copper-lead-zinc ores was only 1.98 per cent of the total.

The production of silver as reported by the mines had increased pretty steadily from 1908 to 1916. A decline during the next three years was followed by partial recovery in 1920, another decline in 1921, a large increase in 1922, a considerable increase in 1923 until after the expiry of the Pittman Act followed by a large decrease in 1924. The combined production of silver from lead and lead-zinc ores increased from 24,457,431 ounces in 1923 to 26,077,241 ounces in 1924. The recovery of silver from siliceous ore decreased about 7,249,000 ounces, and was the smallest recovery since 1919. The recovery from base ores increased about 970,000 ounces.

Mine production of silver in the United States in 1924, by States, in fine ounces [a]

State or Territory	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alaska	22,279	73,990	572,078			1,294		669,641
Arizona	27	610,213	5,101,837	912,741		24,458		6,649,276
California	16,690	2,451,552	876,293	188,098	22,500			3,555,133
Colorado	4,954	1,979,382	24,666	379,635	1,852	21,540	842,341	3,254,370
Georgia		5						5
Idaho	4,248	47,137	504,644	5,815,764		142,419	1,278,942	7,793,154
Illinois [b]				8,891				8,891
Michigan			130,381					130,381
Missouri				103,694				103,694
Montana	187	947,083	7,845,180	287,041		998,369	3,211,443	13,289,303
Nevada	546	8,002,859	106,614	1,093,429		1,786	206,145	9,411,379
New Mexico	27	626,072	131,743	33,233		3,995		795,070
North Carolina	1	30						31
Oregon	2,279	23,130	12,694					38,103
Pennsylvania [c]			2,810					2,810
South Dakota		86,548						86,548
Tennessee			94,779					94,779
Texas		720,739						720,739
Utah	1	4,749,144	887,541	9,936,956		462	1,679,588	17,253,692
Virginia		3						3
Washington	12	70,178	44,173	99,300	79			213,742
	51,251	20,388,065	16,335,433	18,858,782	24,431	1,194,323	7,218,459	64,070,744
Value	$34,338	$13,660,004	$10,944,740	$12,635,384	$16,369	$800,196	$4,836,367	$42,927,398
Percentage	0.08	31.82	25.50	29.43	0.04	1.86	11.27	100.00
1923: Total	57,752	27,636,947	14,684,333	20,139,928	2,171,186	1,348,025	4,317,503	70,355,674
Value	$47,357	$22,662,296	$12,041,153	$16,514,741	$1,780,372	$1,105,380	$3,540,352	$57,691,651
Percentage	0.08	39.28	20.87	28.63	3.08	1.92	6.14	100.00

[a] Philippine Islands and Porto Rico excluded. The Bureau of Science, Manila, P. I., reports that bullion from lode mines of the Philippine Islands yielded 42,464 ounces of silver and placer bullion yielded 663 ounces.
[b] From fluorspar-lead ores.
[c] From pyritiferous magnetite ore.

Silver produced in the United States, by sources, as reported by mines, 1914–1924, in fine ounces

Year	Placers	Dry and siliceous ores	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1914	152,128	27,812,335	14,829,828	19,302,081	145,264	248,866	7,132,747	69,623,249
1915	154,968	25,709,505	18,781,365	19,828,533	1,136,220	234,047	6,509,092	72,353,730
1916	126,351	24,593,656	24,541,234	19,216,586	1,274,292	533,273	8,572,141	78,857,533
1917	118,604	21,489,465	20,314,233	19,096,474	549,656	448,042	8,645,038	70,661,512
1918	89,494	21,564,982	20,462,597	18,291,243	135,676	224,580	7,290,380	68,058,952
1919	78,401	19,043,515	12,880,624	14,351,293	39,480	232,157	5,273,990	51,899,460
1920	73,383	20,477,612	12,151,424	17,069,506	1,258,341	669,503	4,837,135	56,536,904
1921	81,375	24,117,251	4,782,538	14,912,990	6,163	449,417	1,983,222	46,332,956
1922	60,769	28,631,579	10,376,123	16,756,835	1,676,967	669,809	3,035,907	61,207,989
1923	57,752	27,636,947	14,684,333	20,139,928	2,171,186	1,348,025	4,317,503	70,355,674
1924	51,251	20,388,065	16,335,433	18,858,782	24,431	1,194,323	7,218,459	64,070,744

PLACERS

The output of silver from the refining of placer gold in 1924 was 6,501 ounces less than in 1923. Of the total production about 76 per cent came from Alaska and California.

DRY AND SILICEOUS ORES

About 39 per cent of the mine production of silver from dry and siliceous ores in 1924 came from Nevada (chiefly from the Tonopah and Comstock districts), 23 per cent from Utah (mainly from the Tintic district), and 12 per cent from California. The increases in the quantity of silver from siliceous ore were in New Mexico and Alaska and the largest decreases in Utah, Colorado, Arizona, and Nevada.

A large part of the silver from gold-silver siliceous ore is obtained with the gold by amalgamation and cyanidation in the mills, and the silver is then recovered by refining the mill bullion. Very little gold and silver ores are treated by flotation which is so extensively employed on base ores. It is estimated that only 18,000 tons of such ore was so treated in 1923 and a comparatively small tonnage in 1924. The remainder is produced by smelting the richer ore and refining the copper or lead bullion produced.

COPPER ORE

The silver produced from copper ore is obtained in the electrolytic refining of Lake and blister copper produced by smelting. The copper ore consists mainly of sulphides (except the Lake ore of Michigan, which consists of native metal in amygdaloid and conglomerate matrix), and a greater quantity contains chalcocite than chalcopyrite or cupriferous pyrite. The silver tenor of the extensive disseminated deposits of the Santa Rita district, N. Mex., and of Ely, Nev., is notably low, but similar deposits elsewhere add considerable quantities of silver.

In output of silver from copper ore Montana continued to lead, with a yield of 7,845,180 ounces in 1924, against 7,619,864 ounces in 1923. Arizona was next, with 5,101,837 ounces in 1924 against 4,269,278 ounces in 1923. The production from Montana comes mainly from Butte, that of Arizona chiefly from Bisbee and Jerome, that of Utah from Tintic and Bingham, and that of California from Plumas County. Of these districts, Bisbee well represents the disseminated type, Bingham produces from both lode and disseminated deposits, and the remainder produce silver chiefly from copper ore mined from deep lodes. Some silver is also produced in leaching copper ore.

LEAD ORE

The mine production of silver from argentiferous lead ore decreased 6 per cent in quantity in 1924. The output from Idaho increased 326,287 ounces, and the largest decreases were as follows: Utah, 711,996 ounces; Colorado, 246,339 ounces; Arizona, 177,793 ounces; Montana, 150,662 ounces; Nevada, 145,413 ounces; and California, 142,143 ounces. The yield of Idaho is derived mainly from the silver-lead ore of the Coeur d'Alene region, that in Utah chiefly from the Park City and Tintic districts, and that in Colorado from Aspen and Leadville. Most of the output is obtained from the desilverization of lead bullion from smelting of western ores and concentrates.

ZINC, LEAD-ZINC, AND MIXED ORES

Silver from argentiferous zinc ore decreased from 2,171,186 ounces in 1923 to 24,341 ounces in 1924. The output was mainly from

crude zinc ore from California and Colorado shipped to smelters. Silver from lead-zinc ore increased 67 per cent; it came chiefly from Montana, Utah, Idaho, and Colorado. The output of silver from copper-lead and copper-lead-zinc ores came mainly from Montana and Idaho.

DISTRIBUTION OF PRODUCTION OF GOLD AND SILVER, BY METHODS OF TREATMENT

SUMMARY OF DISTRIBUTION

In the following table is given the production of gold and silver from ore, tailings, slag, etc., treated in 1924.

Distribution of gold and silver produced in the United States in 1924, by States [a]

State or Territory	Total quantity of crude ore, tailings, and slag treated or sold in 1924 (short tons)	Ore, tailings, etc., to gold and silver mills				Concentrates from all sources		
		Ore (short tons)	Tailings, etc. (short tons)	Gold in bullion (fine ounces)	Silver in bullion (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	3,889,684	3,127,771	------	[b] 109,255	[b] 58,926	74,452	21,520	389,315
Arizona	19,820,505	98,568	49,947	81,485	40,552	1,062,869	34,027	1,313,711
California	2,019,200	[c] 822,499	88,800	303,292	126,183	85,583	71,800	2,595,817
Colorado	1,514,182	867,367	[d]	277,351	50,740	130,740	78,902	1,844,594
Idaho	1,711,988	17,673	------	5,486	2,696	264,276	2,090	6,413,259
Montana	4,652,482	77,245	21,005	11,790	104,183	1,562,548	71,715	12,138,659
Nevada	4,699,333	970,966	14,941	163,240	7,352,953	396,594	34,014	1,220,103
New Mexico	3,040,652	73,836	------	10,455	566,859	164,009	4,385	65,462
Oregon	44,842	23,178	------	6,211	7,288	4,027	4,177	20,388
South Dakota	1,674,720	1,674,720	[e]	295,930	86,548	------	------	------
Texas	84,744	84,744	------	------	720,739	------	------	------
Utah	13,640,618	61	------	43	111	835,260	97,682	3,724,896
Washington	44,383	1,611	------	941	43	2,998	105	22,009
Eastern States	[f] 1,401,745	2,070	------	248	38	49,242	326	39,489
	58,239,078	[b] 7,842,309	174,693	1,265,727	9,126,859	4,632,598	420,743	29,787,702
Total, 1923	54,695,395	7,574,215	83,398	1,267,952	10,207,483	4,095,854	321,462	29,698,438

State or Territory	Crude ore to concentrating mills (short tons)	Crude ore to smelters			Ore leached and old tailings, slag, etc., treated		
		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	737,646	24,267	888	199,121	------	------	------
Arizona	15,738,134	2,736,651	120,286	5,281,360	1,197,205	46	4,626
California	777,816	236,018	14,455	805,783	94,067	[g] 24,630	[g] 10,660
Colorado	462,361	184,454	39,194	1,354,082	------	------	------
Idaho	1,587,816	71,382	2,021	1,357,207	35,117	1	15,744
Montana	4,201,953	149,251	12,868	944,384	203,028	158	101,890
Nevada	3,511,783	168,438	15,868	609,083	33,205	3,517	228,694
New Mexico	2,820,248	146,568	9,788	162,722	------	------	------
Oregon	21,233	431	557	8,148	------	------	------
Utah	12,911,813	555,474	46,647	12,310,703	173,270	2,104	1,217,981
Washington	21,284	21,488	13,898	191,678	------	------	------
Eastern States	989,439	410,236	217	58,100	------	------	------
	43,781,526	4,704,658	276,687	23,282,471	1,735,892	30,456	1,579,595
Total, 1923	38,630,457	4,965,435	254,507	28,223,206	3,441,890	9,062	1,759,358

[a] Exclusive of silver from copper ore in Michigan and from lead and lead-fluorspar ore in Illinois and Missouri; of gold and silver from siliceous ore in Philippine Islands; and of gold and silver from Porto Rico.

[b] Exclusive of bullion from concentrates amalgamated, figures for which are included under "Concentrates from all sources."

[c] Also 6,897 tons of concentrates from California were cyanided. These concentrates yielded 25,147 ounces of gold and 14,149 ounces of silver. The figures are included under "Concentrates from all sources."

[d] Sands and slimes (269,190 tons) from ore first treated by amalgamation were cyanided.

[e] Sands and slimes (1,647,344 tons) from ore first treated by amalgamation were cyanided.

[f] Includes low-grade pyritiferous magnetite ore from Pennsylvania.

[g] Includes 24,559 ounces of gold and 5,533 ounces of silver from hand-mortared rich ore.

The greatest output of ore, etc., was made in Arizona, Utah, and Montana, all notable for large yields of copper ore; in Idaho, a large producer of lead ore and siliceous ore; in Nevada, Alaska, and California, large producers of both copper and siliceous ores; in South Dakota and Colorado, large producers of siliceous ore; and in New Mexico, a large producer of copper ore.

Many gold and silver mills employ concentrating apparatus, and the concentrates they obtain are combined in the table with those from straight concentrating mills under the heading "Concentrates from all sources." The gold and silver included in this item are recovered partly by amalgamation and cyanidation, although most of the concentrates are smelted.

The figures for the quantity of ore treated by concentration include the large quantities of copper, lead, zinc, and mixed ores whose concentrates are smelted primarily for these metals, the gold and silver being recovered in refining the copper and lead bullion and smelting the zinc residues. Examples are the copper ore of the disseminated deposits of Bingham, Utah, and of New Mexico and Nevada; the copper ore of Butte, Mont., and Ely, Nev.; and the lead and lead-zinc ores of Coeur d'Alene, Idaho, Butte, Mont., and Leadville, Colo. The quantity of concentrates produced and the recoverable gold and silver content represent not only the concentrates from these straight concentrating mills but also the comparatively small quantity from gold and silver mills.

The ore treated in straight concentration mills increased 13 per cent in 1924, mainly because of more activity at copper mines in Arizona, Montana, Nevada, Utah, Alaska, and other States and at lead-zinc mines in Colorado, Montana, and Utah.

About 62 per cent of the recoverable silver from concentrates produced came from Montana and Idaho, and large quantities came from Utah, California, Colorado, and Arizona.

The figures for the quantity and the recoverable precious-metal content of crude ore shipped from the mines direct to the smelters in general include the richer gold, silver, copper, lead, and mixed ores from which the gold and silver is eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting. Arizona produced 58 per cent of the ore directly smelted, and Utah and Arizona produced 76 per cent of the silver recovered from crude ore smelted.

The old materials, mainly tailings and slags, re-treated (with which are included ore and tailings leached) are partly smelted, often for their fluxing as well as their metal value; but considerable quantities of old tailings are now concentrated and cyanided, and the impounding of mill tailings for future treatment, as well as because of legal requirements, has become a general practice. Most of the gold and silver derived from the old tailings is included under recoveries by amalgamation and cyanidation at gold and silver mills. The total quantity of ore leached in 1924 was 1,316,267 short tons, of which 1,195,036 tons came from Arizona and 72,231 tons from Utah. The ore leached in 1923 amounted to 1,951,447 tons. In addition to ore mined and leached, ore was leached in place in Utah and Nevada and the copper recovered by precipitation.

Gold and silver produced at mills in the United States and percentage of gold and silver recovered by smelting and from placers, 1914–1924 [a]

Year	Ore and tailings treated (short tons)	Bullion recovered from all sources (fine ounces)					
		Amalgamation		Cyanidation		Chlorination	
		Gold	Silver	Gold	Silver	Gold	Silver
1914	9,849,085	924,253	271,417	1,384,935	15,399,836	23,488	2,530
1915	11,878,287	1,084,034	382,459	1,444,077	16,184,924	25,081	3,749
1916	11,393,838	964,589	348,177	1,260,172	14,432,378	20,346	2,784
1917	11,076,211	828,681	288,791	1,169,478	11,535,747	9,102	283
1918	8,524,496	678,359	216,670	1,047,186	9,736,605	5,770	3,631
1919	8,668,507	839,761	279,793	685,330	7,163,726	----	----
1920	7,560,043	679,409	228,807	580,205	7,582,358	----	----
1921	7,429,125	765,397	207,877	559,352	7,414,275	----	----
1922	7,442,998	812,396	183,119	541,318	8,803,787	----	----
1923	7,657,613	683,274	179,527	607,415	10,044,388	----	----
1924	8,023,899	746,777	231,742	563,208	8,921,688	----	----

Year	Percentage of gold and silver from all sources									
	Amalgamation		Cyanidation		Chlorination		Placers		Smelting [b]	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1914	20.9	0.4	31.4	22.1	0.4	----	25.2	0.2	22.1	77.3
1915	22.8	.4	30.4	22.1	.5	----	22.7	.2	23.6	77.3
1916	21.5	.4	28.1	18.3	.5	----	25.0	.2	24.9	81.1
1917	20.9	.4	29.5	16.3	.2	----	25.8	.2	23.6	83.1
1918	20.7	.3	32.0	14.3	.2	----	23.6	.13	23.5	85.3
1919	31.5	.5	28.5	13.8	----	----	25.6	.15	14.4	85.5
1920	28.5	.4	24.3	13.4	----	----	25.3	.13	21.9	86.1
1921	32.6	.45	23.9	16.0	----	----	28.9	.18	14.6	83.4
1922	35.4	.3	23.6	14.4	----	----	23.5	.1	17.5	85.2
1923	28.4	.3	25.3	14.3	----	----	22.9	.1	23.4	85.3
1924	30.6	.4	23.0	13.9	----	----	18.4	.1	28.0	85.6

[a] Philippine Islands and Porto Rico excluded. [b] Both crude ores and concentrates.

The dredges produced $2,086,066 less gold in 1924 than in 1923, and the combined placer yield from hydraulic, drift, and other surface mines was $6,106 less than in 1923. The percentage of the output of silver credited to the placers is insignificant. Arizona, California, Colorado, Nevada, and South Dakota ores yielded the larger part of the gold recovered by cyanidation, and the total decrease was mainly due to the large decline in recoveries by the cyanide process in Arizona. The chlorination process has not been used in California since 1918.

GOLD AND SILVER PRODUCED AT MILLS, BY STATES

A large quantity of concentrates from sulphide ores is now smelted, and the increased application of the flotation process has resulted in decreased yield of gold and silver from cyanidation, as nearly all such concentrates are shipped to smelters.

The smelters are to be credited in 1924 with 28 per cent of the total output of gold and 85.6 per cent of the silver.

The bulk of the gold produced continues to come from the gold mills. As shown in the table, the proportion of gold recovered by amalgamation and cyanidation has increased from 49.6 per cent in 1916 to 53.6 per cent in 1924.

Gold and silver bullion produced at mills in 1924, by States [a]

State or Territory	Ore and tailings treated (short tons)	Bullion recovered from all sources (fine ounces)				Percentage of gold and silver from all sources in State			
		Amalgamation		Cyanidation		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Alaska	3,127,771	128,367	71,348			42.2	10.7		
Arizona	148,515	696	482	80,789	49,070	.3		34.2	0.7
California	[b] 918,196	264,904	65,324	63,534	75,008	41.6	1.8	10.0	2.1
Colorado	[c] 867,367	120,686	27,620	156,665	23,120	29.0	.8	37.7	.7
Idaho	17,673	5,314	1,965	172	731	19.7		.6	
Montana	98,250	5,138	1,271	6,652	102,912	5.3		6.8	.8
Nevada	985,907	14,917	10,251	148,323	7,342,702	6.8	.1	68.0	78.0
New Mexico	73,836	425	69	10,030	566,790	1.7		40.4	71.3
Oregon	23,178	1,926	401	4,285	6,887	7.2	1.1	16.1	18.1
South Dakota	[d] 1,674,720	203,174	52,920	92,756	33,628	68.7	61.1	31.3	38.9
Texas	84,744				720,739				100.0
Utah	61	41	10	2	101				
Washington	1,611	941	43			6.3			
Eastern States	2,070	248	38			31.0			
	8,023,899	746,777	231,742	563,208	8,921,688	30.6	.4	23.0	13.9
Value		$15,437,251	$155,267	$11,642,543	$5,977,531				
1923: Total	7,657,613	683,274	179,527	607,415	10,044,388	28.4	.3	25.3	14.3
Value		$14,124,527	$147,212	$12,556,382	$8,236,398				

[a] Philippine Islands and Porto Rico excluded.
[b] Includes 6,897 tons of concentrates cyanided.
[c] Also 269,190 tons of sands and slimes from ore first treated by amalgamation were cyanided.
[d] Also 1,647,344 tons of sands and slimes from ore first treated by amalgamation were cyanided.

The great bulk of the ore treated was milled in Alaska, South Dakota, Nevada, California, Colorado, and Arizona, and here the famous mines and mills of the Homestake, Mother Lode, Grass Valley, Treadwell, Cripple Creek, Tonopah, Goldfield, and San Francisco (Oatman) districts are especially noteworthy. Large numbers of smaller mills, however, mark the wide distribution of gold mining in these regions and in many other scattered districts.

The total yield of gold by amalgamation in the United States in 1924 was 373,567 ounces less than in 1911. The largest increases in 1924 were shown in Alaska, California, Colorado, and Oregon, and there were decreases in Arizona, Idaho, Montana, Nevada, New Mexico, South Dakota, and Washington.

The output of gold by cyanidation was 880,869 ounces less than in 1915. There were increases in California, Colorado, Nevada, and New Mexico. The principal decreases were in Arizona, 61,237 ounces; Montana, 24,616 ounces; and Utah, 2,870 ounces.

Nevada led in yield of silver by cyanidation, producing more than 82 per cent of the total, and the only notable gain was in New Mexico. The decrease in Nevada was 1,043,249 ounces.

Of the gold-producing States whose output is derived chiefly from milling ores, Alaska, California, Idaho, South Dakota, and Washington still yield more gold by amalgamation than by cyanidation, but cyanidation produces more gold than amalgamation in Arizona, Colorado, Montana, Nevada, New Mexico, and Oregon, and it produces much more silver in Arizona, Montana, Nevada, New Mexico, Oregon, and Texas. Only in Alaska, Colorado, Idaho, South Dakota, and Washington did the recovery of silver by amalgamation exceed

that by cyanidation. Altogether amalgamation produced gold and silver valued at $15,592,518 from milling ores in 1924, against $17,620,074 produced by cyanidation.

QUICKSILVER AND POTASSIUM AND SODIUM CYANIDE USED IN CERTAIN STATES

For details of the use of quicksilver in the amalgamation milling process and of potassium cyanide and sodium cyanide in the cyanidation process the reader is referred to the mine reports for the several Western States. The consumption of quicksilver at mills treating ore, in dredging, and in other methods of placer mining is given in the separate chapters on quicksilver in Mineral Resources for 1917–1919.

The following tables were compiled by V. C. Heikes:

Quicksilver purchased for use at mills in five Western States, 1919–1924

State and year	Number of mills using quicksilver	Ore and tailings treated (short tons)	Quicksilver purchased (pounds)[a]	
			Total	Per ounce of gold and silver bullion
Arizona:				
1919	6	2,374	33	0.077
1920	4	1,688	56	.031
1921	9	1,215	68	.066
1922	17	2,375	48	.052
1923	12	1,567	107	.099
1924	13	1,611	30	.025
Idaho:				
1919	12	40,504	828	.0406
1920	9	38,556	737	.053
1921	14	44,545	355	.025
1922	13	21,523	411	.042
1923	20	21,117	250	.035
1924	15	17,337	320	.044
Montana:				
1919	17	13,142	178	.054
1920	11	27,989	250	.046
1921	13	2,562	47	.0225
1922	9	43,757	218	.025
1923	14	62,460	385	.046
1924	15	58,474	97	.015
Nevada:				
1919	21	60,038	1,149	.026
1920	21	41,700	631	.021
1921	23	13,143	224	.009
1922	22	10,875	522	.021
1923	27	25,354	690	.024
1924	25	19,912	584	.023
Washington:				
1921	3	2,930	227	.126
1922	1	8,886	75	.015
1923	2	5,628		
1924	2	1,611	325	.330

[a] Partly estimated.

Quicksilver used at mills in Colorado in 1924 amounted to 2,740 pounds, in New Mexico to 250 pounds, and in South Dakota to 7,625 pounds.

Dredges in California used about 6,200 pounds of quicksilver in 1924. The quicksilver used by other placers and at deep mines is estimated at 6,000 pounds, making a total of more than 12,000 pounds for California. The quantity of quicksilver used in Alaska is not known, but was probably about 10,000 pounds.

Sodium cyanide consumed at mills in certain Western States, 1918–1924, in pounds [a]

State	1918	1919	1920	1921	1922	1923	1924
Arizona	157,204	99,605	219,569	293,597	259,506	330,666	135,971
Colorado	779,741	582,547	338,763	360,000	301,794	309,565	306,196
Idaho	15,600	950	1,600	11,391	4,701	3,900	950
Montana	83,542	64,900	105,874	108,665	291,940	274,218	84,770
Nevada	1,765,010	992,840	1,672,190	1,107,530	1,831,592	3,199,634	2,677,406
New Mexico	79,065	108,805	90,200	80,768	64,544	61,391	112,500
South Dakota	370,218	284,653	[b] 365,095	[b] 672,224	387,683	361,900	361,650
Texas	63,130	38,700	36,976	43,028	74,428	83,804	[b] 70,995
Utah	2,700	37,844	40,599	93,200	118,103	43,731	[c]
Washington				100		50	
	3,316,210	2,210,844	[b] 2,870,866	[b] 2,770,503	3,334,261	4,668,859	[b] 3,750,438

[a] The consumption of potassium cyanide was 625 pounds in 1918, 68,155 pounds in 1919 (17,884 pounds at mills in Arizona and 50,271 pounds at mills in Nevada), 7,825 pounds in 1920 (7,800 pounds at mills in Arizona and 25 pounds at mills in Washington), 5,626 pounds in 1921 (Arizona 4,200 pounds, Idaho 600 pounds, and South Dakota 826 pounds), and 6,610 pounds in 1922 (Arizona 3,550 pounds, Idaho 800 pounds, Montana 1,030 pounds, Nevada 230 pounds, Washington 1,000 pounds). In 1923 Nevada mines used 575 pounds, and in 1924 Nevada mines used 26,300 pounds.

[b] Includes some cyanamid which is reduced to the equivalent of 96 per cent NaCN.

[c] Quantity small; figures not available.

Potassium and sodium cyanide consumed at mills in six Western States, 1919–1924

State and year	Number of mills using cyanidation process	Ore and tailings treated (short tons)	Cyanide consumed (pounds) [a]		
			Total	Per ton of ore and tailings	Per ounce of gold and silver
Arizona:					
1919	8	211,199	117,489	0.56	0.49
1920	4	206,847	227,369	1.10	.85
1921	9	193,414	297,797	1.54	.21
1922	12	188,879	263,056	1.39	1.04
1923	10	242,652	330,666	1.36	.85
1924	7	146,904	135,971	.93	1.05
Idaho:					
1919	3	907	950	1.05	2.07
1920	1	334	1,600	4.79	2.70
1921	4	2,658	11,991	4.51	2.12
1922	3	139	5,501		1.68
1923	3	784	3,900	4.97	5.30
1924	3	336	950	2.83	1.05
Montana:					
1919	11	97,802	64,900	.66	.55
1920	8	60,999	105,874	1.74	1.84
1921	12	73,437	108,665	1.48	1.81
1922	14	113,687	292,940	2.58	2.59
1923	10	151,903	274,218	1.80	2.10
1924	9	39,776	84,770	2.13	.77
Nevada:					
1919	30	614,190	1,043,111	1.70	.18
1920	33	640,690	1,672,190	2.61	.26
1921	19	617,790	1,107,530	1.79	.17
1922	28	833,025	1,831,822	2.20	.24
1923	32	1,246,003	3,200,209	2.57	.375
1924	25	965,995	2,703,706	2.80	.36
Utah:					
1919	1	14,571	37,844	2.60	.57
1920	1	23,682	40,599	1.71	.32
1921	1	33,616	93,200	2.77	.74
1922	1	33,247	118,103	3.55	1.25
1923	1	14,301	43,731	3.06	1.06
1924			[b]		
Washington:					
1920	1	8	25	3.13	1.04
1921	1	30	100	3.33	.19
1922	1	241	1,000	4.15	.34
1923	1	12	50	4.17	6.25
1924					

[a] Partly estimated.

[b] Quantity small; figures not available.

It has not been possible to obtain figures showing the total quantity of potassium cyanide and sodium cyanide used in the recovery of gold and silver in the United States in 1924. The estimated quantity used in California, 370,000 pounds, and in Oregon, 52,000 pounds, plus the 3,776,738 pounds reported to have been used in other Western States indicates a total consumption of about 4,200,000 pounds.

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GOLD AND SILVER IN SOUTH DAKOTA

(MINE REPORT)

By Charles W. Henderson

PRODUCTION

During 1924 there were four producing deep mines in South Dakota, as compared with five in 1923. There was no production from placer mines in 1923 or 1924. The mills of the State treated 1,674,720 tons of ore, which yielded as bullion $6,117,421 in gold, and 86,548 ounces of silver valued at $57,987, an average recovery per ton of $3.653 in gold and 0.0517 ounce in silver, as compared with $3.846 in gold and 0.0575 ounce in silver in 1923.

Mine production of gold and silver in South Dakota, 1923–24

Year	Number of producing mines	Ore (short tons)	Gold		Silver		Total value
			Fine ounces	Value	Fine ounces	Value	
1923	5	1,665,439	309,905.05	$6,406,306	95,844	$78,592	$6,484,898
1924	4	1,674,720	295,930.24	6,117,421	86,548	57,987	6,175,408
Increase or decrease from 1923	−1	+9,281	−13,974.81	−288,885	−9,296	−20,605	−309,490

Gold and silver bullion produced at mills in South Dakota in 1924

Process	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used	Sodium cyanide used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	1,674,720	203,174.24	52,920	7,625	
Cyanidation	[a] 1,647,344	92,756.00	33,628		[b] 361,650
		295,930.24	86,548	7,625	[b] 361,650

[a] Sands and slimes from 1,670,300 tons of ore originally treated by amalgamation.
[b] Equivalent to 96–98 per cent NaCN.

Mine production of gold and silver in South Dakota, 1914–1924[a]

Year	Gold	Silver		Total value (commercial)
		Fine ounces	Commercial value	
1914	$7,333,508	176,642	$97,683	$7,431,191
1915	7,406,305	199,864	101,331	7,507,636
1916	7,460,644	215,205	141,605	7,602,249
1917	7,364,233	186,765	153,894	7,518,127
1918	6,565,337	159,202	159,202	6,724,539
1919	4,863,040	116,493	130,472	4,993,512
1920	4,676,470	90,795	98,966	4,775,436
1921	6,605,167	112,464	112,464	6,717,631
1922	6,517,788	118,760	118,760	6,636,548
1923	6,406,306	95,844	78,592	6,484,898
1924	6,117,421	86,548	57,987	6,175,408

[a] For yearly output to 1913 and authority for each year, see Mineral Resources, 1913, pt. 1, p. 42, 1914.

MINING INDUSTRY

At the Homestake mine, from which the bulk of the production of South Dakota has come since 1875, production was continuous in 1924. Minor operations are noted in the review by counties.

REVIEW BY COUNTIES

CUSTER COUNTY

There was no production and nothing but assessment work done at the placer and lode deposits of Custer County.

LAWRENCE COUNTY [1]

Mine production of gold, silver, copper, and lead in Lawrence County, S. Dak., 1916–1924

Year	Number of mines producing	Ore	Gold[a]	Silver[a]	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1916	29	1,870,572	$7,455,136	215,127	----------	35,406	$7,599,127
1917	24	1,868,143	7,360,266	186,436	736	60,905	7,519,328
1918	13	1,781,661	6,564,850	158,108	2,996	11,536	6,724,517
1919	5	1,329,928	4,863,013	116,010	----------	6,585	4,993,293
1920	7	1,356,189	4,676,470	90,795	----------	12,812	4,776,461
1921	3	1,725,685	6,603,318	112,457	----------	4,000	6,715,955
1922	4	1,751,414	6,515,969	118,753	----------	----------	6,634,722
1923	4	1,665,437	6,406,206	95,844	----------	----------	6,484,798
1924	1	1,670,300	6,091,100	86,354	----------	----------	6,148,957

[a] Includes both placer and deep mine production.

The total value of the product of the Homestake Mining Co. from 1875 to 1924 is $194,545,685.84, and the amount paid in dividends is $47,068,804.29.

[1] For information on the geology of this county, see Irving, J. D., Ore deposits of the northern Black Hills: U. S. Geol. Survey Bull. 225, 1904, pp. 123–140; Irving, J. D., and Emmons, S. F., Economic resources of the northern Black Hills: U. S. Geol. Survey Prof. Paper 26, 1904, pp. 53–212.

Ore milled, receipts, and dividends, Homestake mine, 1916–1924

Year	Ore milled	Receipts for bullion product		Dividends
		Total	Per ton	
	Short tons			
1916	1,600,220	$6,531,003.34	$4.0813	$2,210,208
1917	1,677,623	6,619,573.94	3.9458	1,959,048
1918	1,628,630	5,916,890.31	3.6330	1,506,960
1919	1,192,588	4,346,115.79	3.6443	1,130,220
1920	1,274,944	4,410,193.73	3.4591	
1921	1,620,588	6,299,780.38	3.8873	502,320
1922	1,663,485	6,285,317.56	3.7784	879,060
1923	1,652,337	6,400,078.42	3.8733	1,506,960
1924	1,670,300	6,126,349.99	3.6678	1,758,120

The annual report of the superintendent of the Homestake Mining Co.[2] for the year ended December 31, 1924, says:

Nothing has occurred during the year just passed to interrupt mining and milling the normal tonnage of ore.

Stripping at the coal mine, located near Gillette, Wyo., has reached a stage which assures production of the company's requirements of steam coal after April 1, 1925. The operation of the coal mine should effect a material decrease in steam power costs.

The tube mills, formerly located in the regrind plant, have been moved to the Amicus mill; some of the amalgamating plates have been removed to make the necessary room. This permits coarser crushing with the stamps and in consequence an increased tonnage, besides effecting considerable economy of operation.

After a year of continuous operation of the Ellison electric hoist, during which time 4,000 tons of ore has been hoisted per day, this installation has proven to be dependable and economical.

The engineers report as follows:

Development drifts driven, 11,975 feet.

Development raises driven, 3,255 feet.

B. & M. No. 2 shaft has been excavated and timbered from the surface to a depth of 308 feet.

There are 686,918 tons of ore broken down and remaining in the stopes.

There are 15,815,118 tons of ore blocked out and remaining in the mine.

PENNINGTON COUNTY

Keystone district.—The Keystone Arsenic Co. operated from January to August the old Bullion group and the 40-ton 10-stamp amalgamation and concentration plant at Keystone. It shipped some of the arsenopyrite-pyrite-gold concentrates direct to smelters and roasted some in a small arsenic furnace, sending the calcines to smelters. The arsenious oxide made was re-roasted, barreled, and shipped. The arsenic plant was operated from July 13 to December 1.

Redfern district.—Shaft and open-cut development late in 1923 on the O. K. group yielded several tons of ore, from which was recovered in December, 1923, in a two-stamp amalgamation mill on the property, a small quantity of gold bullion that was marketed in December, 1923, and January, 1924. From lack of a concentrating

[2] For description of geology, see Paige, Sidney, The geology of the Homestake mine; Econ. Geology, vol. 18, pp. 205–237, 1923; Geology of the region around Lead, S. Dak., and its bearing on the Homestake ore body; U. S. Geol. Survey Bull. 765, 1924; U. S. Geol. Survey Geol. Atlas, Central Black Hills folio (No. 219), 1925; Hosted, J. O., and Wright, L. B., Geology of the Homestake ore bodies and the Lead area, South Dakota; Eng. and Min. Jour.-Press, May 5, 1923, pp. 793–799; May 12, 1923, pp. 836–843.

table, no attempt was made to save the arsenical pyrite that formed part of the ore treated. In 1924 the 125-foot shaft was retimbered for 40 feet and drifting was done at the 30 and 60 foot levels. Some encouraging gold assays were obtained but no ore was treated. Assays of material from another vein on the property showed presence of lead and silver. Trenching on the Doctor No. 2 lode with team and scraper to a maximum depth of 20 feet yielded decomposed rock and quartz which was crushed in a 1,000-pound stamp mill and then in the operator's patented (Nelson) concentrator. The free gold obtained was sold to tourists and jewelers.

GOLD, SILVER, AND COPPER IN WYOMING

(MINE REPORT)

By Charles W. Henderson

PRODUCTION

Nothing but assessment work was done in the metal-mining districts of Wyoming in 1924. Mine production of gold, silver, and copper in Wyoming from 1915 to 1923 is given in the table below:

Mine production of gold, silver, and copper in Wyoming, 1915–1923 [a]

Year	Ore (short tons)	Gold	Silver		Copper		Total value
			Fine ounces	Commercial value	Pounds	Value	
1915	4,216	$14,592	840	$426	447,246	$78,268	$93,286
1916	8,876	20,566	5,524	3,635	2,610,622	642,213	666,414
1917	6,335	3,762	3,415	2,814	2,027,857	553,605	560,181
1918	2,870	871	965	965	852,777	210,636	212,472
1919	798	84	151	169	139,900	26,021	26,274
1920							
1921	50	62	111	111	10,000	1,290	1,463
1922	24	1,207	57	57	4,296	580	1,844
1923	584	296	254	208	111,280	16,358	16,862

[a] For yearly output, 1842–1914, see Mineral Resources, 1914, pt. 1, pp. 248–249, 1916.

References to the districts can be found in Mineral Resources for 1923 and for earlier years.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Charles W. Henderson

PRODUCTION

The total calculated gross value of the recovered and estimated recoverable gold, silver, copper, lead, and zinc from gravels treated and ores mined in Colorado in 1924 showed an increase of less than 1 per cent over the gross value in 1923. There were appreciable increases in gold, lead, and zinc, but decreases in silver and copper.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1923–24 [a]

Year	Number of producing mines	Ore	Gold		Silver [b]	Copper	Lead	Zinc	Total value
			Placer	Deep					
		Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1923	417	1,569,100	$364,429	$6,227,200	5,334,488	4,248,109	45,698,185	54,152,000	$18,471,590
1924	358	1,514,182	418,506	8,174,610	3,254,370	2,713,219	47,557,061	56,727,000	18,620,796
Increase or decrease from 1923	−59	−54,918	+54,077	+1,947,410	−2,080,118	−1,534,890	+1,858,876	+2,575,000	+149,206

[a] A revised table showing the production of gold, silver, copper, lead, and zinc from the beginning of mining in Colorado to 1923 is included in U. S. Geol. Survey Prof. Paper 138, Mining in Colorado, 1926.
[b] Includes placer production, as follows: 1923, 4,122 ounces; 1924, 4,954 ounces.

ORE

In 1924 amalgamating and cyaniding mills with and without concentrating equipment treated 867,367 tons of ore, from which were recovered in bullion and cyanide precipitates 277,350.83 fine ounces of gold, 50,740 fine ounces of silver, and 28,607 short tons of concentrates. These concentrates contained recoverable metals, as follows: 44,451.11 fine ounces of gold, 831,044 fine ounces of silver, 171,814 pounds of copper, and 6,007,019 pounds of lead. The average recovery per ton of ore treated was 0.371 ounce of gold and 1.02 ounces of silver. A total of 462,361 tons of ore went directly to concentrating mills and yielded 102,133 tons of concentrates, or at a ratio of 5 to 1. From these concentrates were recovered 34,450.97 fine ounces of gold, 1,013,550 fine ounces of silver, 1,920,911 pounds of copper, 25,166,292 pounds of lead, and 43,370,000 pounds

of zinc. Lead concentrates amounting to 56,052 tons contained 25,994,555 pounds of lead, and 4,045 tons of copper-lead concentrates contained 1,214,342 pounds of lead. Lead-zinc concentrates amounting to 55,925 tons contained 3,869,517 pounds of lead. The concentrates of all other classes contained only small quantities of lead. The smelting ores contained 16,383,750 pounds of lead, as compared with 12,920,976 pounds in 1923 and 11,249,761 pounds in 1922.

GOLD

The mine production of gold in 1924 was 415,691.98 fine ounces, valued at $8,593,116, an increase of 96,821.93 fine ounces and of $2,001,487 over 1923. This increase followed an increase of 10,555.90 fine ounces and of $218,210 in 1923, and decreases of $461,909 in 1922, $740,991 in 1921, and $2,310,308 in 1920.

The Cripple Creek district increased its output over 1923 and contributed 58 per cent of the total State yield as compared with 61 per cent in 1922. The part of the San Juan region that includes Dolores, La Plata, Ouray, San Juan, and San Miguel Counties yielded $2,075,898, an increase of $381,942. There were increases of $2,092 in Clear Creek County, $11,163 in Gilpin County, $708,650 in Lake County, $7,597 in La Plata County, $1,896 in Rio Grande County, $162,297 in San Juan County, $260,100 in San Miguel County, $59,344 in Summit County, and $894,897 in Teller County, and decreases of $4,468 in Boulder County, $8,501 in Chaffee County, $2,470 in Dolores County, $11,519 in Eagle County, $8,238 in Gunnison County, $900 in Mineral County, $45,582 in Ouray County, $22,111 in Park County, and $3,939 in Saguache County.

The output of placer gold in 1924 was $418,506, an increase of $54,077. Summit County, with two dredges, four sluice mines, and two hydraulic mines, produced 67 per cent of the placer gold, and Park County produced 27 per cent. Other placer-producing counties were Adams, Lake, Moffat, and Montrose.

SILVER

The mine production of silver in 1924 was valued at $2,180,428, a decrease of $2,193,852 from 1923. There were large decreases in production in Clear Creek, Eagle, Lake, Ouray, Pitkin, Saguache, and San Miguel Counties and smaller decreases in Boulder, Dolores, Gilpin and Summit Counties. There were large increases in production in Gunnison and San Juan Counties and smaller increases in Mineral and Teller Counties.

COPPER

The mine production of copper in 1924 was valued at $355,432, a decrease of $269,040 from 1923. San Juan County produced 59 per cent of the copper output, San Miguel 18 per cent, and Eagle 13 per cent

LEAD

The lead produced in 1924, reckoned as lead in lead bullion and as lead in leaded zinc oxide, was valued at $3,804,565, an increase of $605,692 from 1923. San Juan County was first in rank as a lead

producer in 1924 and was followed in order by Lake, San Miguel, Gunnison, Eagle, Summit, and Custer Counties.

ZINC

The zinc-bearing ores sold contained recoverable zinc valued at $3,687,255, an increase of $4,919. Eagle County produced 22,132,000 pounds, or 39 per cent of the zinc output of the State, as compared with 44 per cent in 1923 and 47 per cent in 1922. Lake County produced 9,191,000 pounds, or 16 per cent of the total, in 1924, as against 9,415,000 pounds, or 17 per cent, in 1923 and 9,003,000 pounds, or 39 per cent, in 1922. San Juan County produced 17,579,000 pounds, or 31 per cent of the total, in 1924, as against 9,540,000 pounds, or 18 per cent, in 1923 and 1,300,000 pounds, or 6 per cent, in 1922. Other producing counties in order of production were Gunnison, Summit, Pitkin, San Miguel, Saguache, Clear Creek, Mineral, Dolores, Park, and Gilpin.

Zinc and lead-zinc ore and concentrates as sold at the mine in Colorado in 1924 to custom milling plants, zinc retort furnaces, and zinc oxide plants

Classification	County	Short tons	Estimated recoverable zinc	Zinc content	Average assay of zinc	Average wet assay of lead
			Pounds	*Pounds*	*Per cent*	*Per cent*
Zinc-lead sulphide ore and concentrates.	Lake and Gunnison	21,189	7,105,600	9,246,037	21.82	12.81
Zinc oxidized ore	Lake	18,801	5,796,000	7,354,560	19.56	
Zinc ore and concentrates.	Clear Creek and Gilpin.	163	59,800	79,679	24.44	
Do	Eagle, Park, Pitkin, and Summit.	85,211	25,730,200	36,482,965	21.41	
Do	Dolores, Mineral, Saguache, and San Juan.	20,574	17,757,400	21,413,437	52.04	
		145,938	56,449,000	74,576,678	25.55	

OUTPUT OF ORE AND RECOVERED METAL CONTENT

Ore and metals produced in Colorado in 1924, by sources

Source of production	Ore		Gold		Silver	
	Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	513,083	33.88	288,738.98	69.46	86,844	2.67
Dry gold and silver ore	435,876	28.79	78,811.00	18.96	936,118	28.76
Dry silver ore	125,917	8.32	1,966.08	.47	956,420	29.39
	1,074,876	70.99	369,516.06	88.89	1,979,382	60.82
Copper ore	1,803	.12	2,136.19	.51	24,666	.76
Copper-lead ore	425	.03	303.50	.07	21,540	.66
Lead ore	67,979	4.49	3,586.75	.86	379,635	11.67
Lead-zinc ore	350,153	23.12	19,877.46	4.78	842,341	25.89
Zinc ore	18,946	1.25	26.79	.01	1,852	.05
	439,306	29.01	25,930.69	6.23	1,270,034	39.03
Total deep mines	1,514,182	100.00	395,446.75	95.12	3,249,416	99.85
Total placers			20,245.23	4.88	4,954	.15
Total deep mines and placers, 1924	1,514,182	100.00	415,691.98	100.00	3,254,370	100.00
Total deep mines and placers, 1923	1,569,100		318,870.05		5,334,488	
Increase or decrease from 1923	−54,918		+96,821.93		−2,080,118	

Ore and metals produced in Colorado in 1924, by sources—Continued

Source of production	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	55,190	2.03	138,884	0.29		
Dry gold and silver ore	525,702	19.38	7,206,007	15.15	278,000	0.49
Dry silver ore	401,365	14.79	5,630,165	11.84		
	982,257	36.20	12,975,056	27.28	278,000	.49
Copper ore	119,315	4.39	24,219	.05		
Copper-lead ore	41,498	1.53	104,456	.22		
Lead ore	38,441	1.42	9,023,359	18.97		
Lead-zinc ore	1,531,708	56.46	25,419,677	53.46	50,608,000	89.21
Zinc ore			10,294	.02	5,841,000	10.30
	1,730,962	63.80	34,582,005	72.72	56,449,000	99.51
Total deep mines, 1924	2,713,219	100.00	47,557,061	100.00	56,727,000	100.00
Total deep mines, 1923	4,248,109		45,698,185		54,152,000	
Increase or decrease from 1923	−1,534,890		+1,858,876		+2,575,000	

Placer output in Colorado in 1924, in fine ounces

County	Sluicing and hydraulic		Dredging		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Adams	35.22	6			35.22	6
Lake	13.59	3	1,120.95	339	1,134.54	342
Moffat	1.40				1.40	
Montrose	18.72	6			18.72	6
Park	10.84	3	5,482.05	1,191	5,492.89	1,194
Summit	231.08	63	13,331.38	3,343	13,562.46	3,406
	310.85	81	19,934.38	4,873	20,245.23	4,954
Total, 1923	269.22	66	17,360.03	4,056	17,629.25	4,122
Increase from 1923	41.63	15	2,574.35	817	2,615.98	832

Ores sold or treated in Colorado in 1924, with content in terms of recovered metals

Dry gold ore

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	2,444	1,044.60	2,006		142	
Clear Creek	5,190	824.99	2,706	2,584	14,127	
Custer	1,510	140.67	1,566			
Eagle	28	14.60	133			
Gilpin	3,654	948.11	2,858	6,410	6,338	
Gunnison	1,636	646.73	3,215		4,463	
Lake	34,368	40,971.96	21,205	6,798	65,969	
La Plata	1,241	1,118.21	10,029	488	154	
Ouray	340	260.18	1,554	1,302	8,871	
Park	5,095	594.75	1,293			
Rio Grande	15	172.12	109		1,600	
San Juan	10,710	917.40	9,192	37,608	37,220	
San Miguel	2,107	1,968.62	2,878			
Summit		51.39	24			
Teller	444,745	239,064.65	28,076			
	513,083	288,738.98	86,844	55,190	138,884	
Total, 1923	410,468	209,867.04	56,837	30,152	113,264	
Increase from 1923	102,615	78,871.94	30,007	25,038	25,620	

Ores sold or treated in Colorado in 1924, with content in terms of recovered metals—Continued

Dry gold and silver ore

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	25	19.88	309			
Clear Creek	655	76.81	2,031	660	34,343	
Gilpin	228	30.61	1,287		12,873	
Lake	2,197	1,733.90	20,135	46,778	31,092	
La Plata	14	13.80	287			
San Miguel	430,481	76,837.70	905,172	478,264	7,049,530	278,000
Summit	2,276	98.30	6,897		78,169	
	435,876	78,811.00	936,118	525,702	7,206,007	278,000
Total, 1923	480,340	67,260.95	1,567,091	1,375,938	10,202,564	
Increase or decrease from 1923	−44,464	+11,550.05	−630,973	−850,236	−2,996,557	+278,000

Dry silver ore

Boulder	52	1.40	152	695	2,887	
Chaffee	27	1.89	958		1,440	
Clear Creek	2,038	41.92	12,780		87,381	
Custer	86	2.70	2,451	723	4,715	
Dolores	11	11.71	1,209		324	
Eagle	24,210	1,123.42	177,025	353,821	515,021	
Gilpin	91	2.48	361		6,867	
Gunnison	21	.19	124			
Hinsdale	769	17.18	8,106	3,692	25,858	
Lake	68,473	137.30	268,263	972	3,760,857	
La Plata	40	4.90	1,281		233	
Mineral	4,373	6.60	235,108		121,026	
Ouray	23,049	361.99	160,745	6,511	790,212	
Park	3	3.50	965		349	
Saguache	59	.30	3,390			
San Juan	2,338	40.60	7,515	25,642	200,427	
San Miguel	261	208.00	75,895	9,309	111,870	
Summit	16		92		698	
	125,917	1,966.08	956,420	401,365	5,630,165	
Total, 1923	275,662	6,247.87	2,330,396	1,386,215	8,382,956	
Decrease from 1923	149,745	4,281.79	1,373,976	984,850	2,752,791	

Copper ore •

Chaffee	106	1.60	318	20,690		
Clear Creek	146	354.43	1,815	11,814	1,413	
Eagle	43	119.50	747	3,912		
Gilpin	340	829.37	2,095	18,321		
Lake	1,147	823.90	19,396	62,935	22,806	
Saguache	21	7.39	295	1,643		
	1,803	2,136.19	24,666	119,315	24,219	
Total, 1923	4,655	2,139.88	110,552	302,685	71,194	
Decrease from 1923	2,852	3.69	85,886	183,370	46,975	

Copper-lead ore

Clear Creek	139	213.44	1,207	7,259	23,232	
Gilpin	32	38.70	183	1,699	6,581	
Hinsdale	54	2.92	7,102	5,384	5,946	
Ouray	28	36.44	426	1,950	4,180	
Park	172	12.00	12,622	25,206	64,517	
	425	303.50	21,540	41,498	104,456	
Total, 1923	380	122.57	16,680	23,502	76,492	
Increase from 1923	45	180.93	4,860	17,996	27,964	

• All smelting ore.

Ores sold or treated in Colorado in 1924, with content in terms of recovered metals—Continued

Lead ore

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	104	31.17	13,469	236	16,221	
Chaffee	748	411.18	8,391	2,180	161,335	
Clear Creek	562	51.43	43,456	1,721	73,005	
Custer	30,443	16.07	17,041	1,559	2,142,822	
Dolores	502	8.61	8,433	11,462	158,733	
Eagle	7	1.10	108		6,663	
Gilpin	301	88.53	6,565	104	126,625	
Gunnison	552	17.80	7,072	1,117	297,494	
Hinsdale	215	6.60	1,568	413	174,433	
Lake	26,328	1,850.00	138,212	4,372	4,174,184	
Mineral	148	51.60	3,801		51,674	
Ouray	30	.50	3,620		8,150	
Park	271	630.70	679		34,520	
Pitkin	5,285		64,661		772,756	
Saguache	3	.40	450		214	
San Juan	497	187.33	13,320	8,598	230,666	
San Miguel	562	33.72	10,194	6,679	100,925	
Summit	1,421	200.01	38,595		492,939	
	67,979	3,586.75	379,635	38,441	9,023.359	
Total, 1923	90,410	3,339.22	625,974	143,791	10,675,407	
Increase or decrease from 1923	−22,431	+247.53	−246,339	−105,350	−1,652,048	

Lead-zinc ore

Clear Creek	1,585	17.29	6,820		38,724	46,400
Dolores	49		276	332	18,356	21,800
Eagle	(b)	(b)	(b)		(b)	(b)
Gilpin	250	10.76	115		4,634	9,600
Gunnison	9,376	90.70	53,695	348	2,983,581	3,710,600
Lake	14,279	763.35	51,907	1,023	1,632,679	3,395,000
Mineral	126	14.07	240		18,862	41,000
Park	61	6.30	153		10,676	20,000
Pitkin	646		8,666		136,882	354,000
Saguache	1,238	5.94	5,804	105	86,161	115,600
San Juan	220,245	18,411.86	659,629	1,529,900	17,091,600	17,579,000
Summit and Eagle	102,298	557.19	55,036		3,397,522	25,315,000
	350,153	19,877.46	842,341	1,531,708	25,419,677	50,608,000
Total, 1923	214,185	11,966.62	571,619	966,843	15,519,061	21,021,400
Increase from 1923	135,968	7,910.84	270,722	564,865	9,900,616	29,586,600

Zinc ore

Gilpin	19	3.81	97		1,457	3,800
Lake	18,801					5,796,000
Summit	126	22.98	1,755		8,837	41,200
	18,946	26.79	1,852		10,294	5,841,000
Total, 1923	93,000	296.65	51,217	18,983	657,247	33,130,600
Decrease from 1923	74,054	269.86	49,365	18,983	646,953	27,289,600

[b] Included with Summit County.

Mine production of metals from gold and silver mills in Colorado in 1924

County	Ore to gold and silver mills	Recovered in bullion		Concentrates and recovered metal content				
		Gold	Silver	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Boulder	2,411	541.94	61	142	374.62	1,439		
Clear Creek	3,700	167.48	104	114	268.53	642	1,023	13,925
Custer	1,498	50.57	501					
Gilpin	3,195	388.27	139	342	157.06	1,342	324	6,781
Gunnison	1,600	485.73	335	38	73.30	2,566		3,150
Lake	200	5,702.16	1,490	18	7.80	119		5,084
La Plata		21.89	13					
Ouray	10	4.26						
Park	5,000	428.07	811					
San Miguel	405,008	30,444.42	19,186	27,953	43,569.80	824,936	170,467	5,978,079
Summit		51.39	24					
Teller	444,745	239,064.65	28,076	(a)	(a)	(a)		
	867,367	277,350.83	50,740	28,607	44,451.11	831,044	171,814	6,007,019
Total, 1923	817,328	221,022.18	44,257	33,386	33,592.14	1,520,881	402,831	6,871,134
Increase or decrease from 1923	+50,039	+56,328.65	+6,483	−4,779	+10,858.97	−689,837	−231,017	−864,115

• Concentrates produced were cyanided and contents are included in bullion recovered.

NOTE.—Average recovery per ton in bullion and concentrates: Gold, 0.371 ounce; silver, 1.0166 ounces.

Mine production of metals from concentrating mills in Colorado in 1924

County	Ore to concentrating mills	Concentrates and recovered metal content					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	52	13	1.40	152	695	2,887	
Clear Creek	5,698	777	453.80	25,942	2,093	160,269	46,400
Custer	30,000	1,500				2,070,000	
Eagle	(a)	(a)	(a)	(a)		(a)	(a)
Gilpin	824	144	185.54	2,210	2,733	22,835	9,600
Hinsdale	715	53	13.70	5,928	2,961	23,525	
Lake	34,953	8,472	8,580.15	9,682	1,023	86,515	69,000
Ouray	23,299	2,573	464.05	161,310	6,661	796,445	
Saguache	1,200	231	4.94	5,493	105	78,029	108,000
San Juan	233,293	42,424	19,356.06	676,308	1,593,150	17,329,247	17,579,000
San Miguel	27,985	4,446	4,770.10	67,192	311,490	1,132,798	278,000
Summit and Eagle	104,342	41,500	621.23	59,333		3,463,742	25,280,000
	462,361	102,133	34,450.97	1,013,550	1,920,911	25,166,292	43,370,000
Total, 1923	549,522	117,180	29,188.78	1,701,789	2,508,793	25,906,075	41,164,400
Increase or decrease from 1923	−87,161	−15,047	+5,262.19	−688,239	−587,882	−739,783	+2,205,600

• Included with Summit County.

Mine production of metals from Colorado concentrates in 1924

By counties

	Concentrates	Recovered metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	155	376.02	1,591	695	2,887	
Clear Creek	891	722.33	26,584	3,116	174,194	46,400
Custer	1,500				2,070,000	
Eagle	[a]	[a]	[a]		[a]	[a]
Gilpin	486	342.60	3,552	3,057	29,616	9,600
Gunnison	38	73.30	2,566		3,150	
Hinsdale	53	13.70	5,928	2,961	23,525	
Lake	8,490	8,587.95	9,801	1,023	91,599	69,000
Ouray	2,573	464.05	161,310	6,661	796,445	
Saguache	231	4.94	5,493	105	78,029	108,000
San Juan	42,424	19,356.06	676,308	1,593,150	17,329,247	17,579,000
San Miguel	32,399	48,339.90	892,428	481,957	7,110,877	278,000
Summit and Eagle	41,500	621.23	59,333		3,463,742	25,280,000
	130,740	78,902.08	1,844,594	2,092,725	31,173,311	43,370,000
Total, 1923	150,566	62,780.92	3,222,670	2,911,624	32,777,209	41,164,400
Increase or decrease from 1923	−19,826	+16,121.16	−1,378,076	−818,899	−1,603,898	+2,205,600

By kinds of concentrates

Dry gold	10,304	10,828.49	22,682	39,368	48,244	
Dry gold and silver	483	828.21	9,188	1,441	34,538	
Dry silver	4	1.00	1,091	118	361	
Copper	38	134.53	341	2,556		
Copper-lead	4,045	3,767.79	58,645	330,167	1,214,342	278,000
Lead	56,052	60,588.87	1,558,486	1,331,638	25,994,555	
Total to copper and lead plants	70,926	76,148.89	1,650,433	1,705,288	27,292,040	[b] 278,000
Lead-zinc	55,925	2,738.00	192,092	387,437	3,869,517	39,873,500
Zinc	3,889	15.19	2,069		11,754	3,218,500
Total to zinc and zinc-lead plants	59,814	[c] 2,753.19	[c] 194,161	[c] 387,437	[d] 3,881,271	[e] 43,092,000
	130,740	78,902.08	1,844,594	2,092,725	31,173,311	43,370,000

Average recoverable content of concentrates

	Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*
Dry gold	1.05	2.20	0.19	0.23	
Dry gold and silver	1.71	19.02	.15	3.58	
Dry silver	.25	272.75	1.48	4.51	
Copper	3.54	8.97	3.36		
Copper-lead	.93	14.50	4.08	15.01	[f]
Lead	1.08	27.80	1.19	23.19	
Average	1.07	23.27	1.20	19.24	[f]
Lead-zinc	.05	3.43	.35	3.46	[g] 43.86
Zinc		.53		.15	[g] 50.05
Average	.05	3.25	.32	3.24	[g] 44.64

[a] Included with Summit County.
[b] Sold to chemical market.
[c] Recovered in zinc residues.
[d] Lead recovered in zinc residues and leaded zinc oxide.
[e] Zinc recovered as metal and zinc in zinc oxide.
[f] Bureau of Mines not at liberty to publish figures.
[g] Assay of content; no deduction for loss in smelting.

Mine production of metals from Colorado crude ore shipped to smelters in 1924

By counties

	Crude ore	Recovered metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	162	179.09	14,284	236	16,363	
Chaffee	881	414.67	9,667	22,870	162,775	
Clear Creek	917	690.50	44,127	20,922	98,031	
Custer	541	108.87	20,557	2,282	77,537	
Dolores	562	20.32	9,918	11,794	177,413	21,800
Eagle	24,288	1,258.62	178,013	357,733	521,684	
Gilpin	896	1,221.50	9,870	23,477	135,759	3,800
Gunnison	9,985	196.39	61,205	1,465	3,282,388	3,710,600
Hinsdale	323	13.00	10,848	6,528	182,712	
Lake	130,440	31,990.30	507,827	121,855	9,595,988	9,122,000
La Plata	1,295	1,115.02	11,584	488	387	
Mineral	4,647	72.27	239,149		191,562	41,000
Ouray	138	190.80	5,035	3,102	14,968	
Park	602	819.18	14,901	25,206	110,062	20,000
Pitkin	5,931		73,327		909,638	354,000
Rio Grande	15	172.12	109		1,600	
Saguache	121	9.09	4,446	1,643	8,346	7,600
San Juan	497	201.13	13,348	8,598	230,666	
San Miguel	418	263.72	82,825	12,295	151,448	
Summit	1,795	257.25	43,042		514,423	76,200
	184,454	39,193.84	1,354,082	620,494	16,383,750	13,357,000
Total, 1923	202,250	17,437.70	2,063,439	1,336,485	12,920,976	12,987,600
Increase or decrease from 1923	−17,796	+21,756.14	−709,357	−715,991	+3,462,774	+369,400

By kinds of ore

Dry gold	3,808	29,099.48	31,418	11,919	67,741	
Dry gold and silver	2,244	1,771.58	20,832	46,778	31,092	
Dry silver	97,700	1,527.32	771,416	365,556	4,522,386	
Copper	1,803	2,136.19	24,666	119,315	24,219	
Copper-lead	425	303.50	21,540	41,498	104,456	
Lead	37,537	3,568.55	371,447	34,748	6,888,960	
Total to lead and copper plants	143,517	38,406.62	1,241,319	619,814	11,638,854	
Lead-zinc	21,991	760.43	110,911	680	4,734,602	7,516,000
Zinc	18,946	26.79	1,852		10,294	5,841,000
Total to zinc smelters and zinc oxide plants	40,937	[a] 787.22	[a] 112,763	[a] 680	[b] 4,744,896	[c] 13,357,000
	184,454	39,193.84	1,354,082	620,494	16,383,750	13,357,000

Average recoverable content of crude ore smelted

	Fine ounces per ton	*Fine ounces per ton*	*Per cent*	*Per cent*	*Per cent*
Dry gold	7.64	8.25	0.16	0.89	
Dry gold and silver	.79	9.28	1.04	.69	
Dry silver	.02	7.90	.19	2.31	
Copper	1.19	13.68	3.31	.67	
Copper-lead	.71	50.68	4.88	12.29	
Lead	.10	9.90	.05	9.18	
Average	.27	8.65	.22	4.05	
Lead-zinc	.03	5.04		10.76	[d] 22.16
Zinc		.10		.03	[d] 19.57
Average	.02	2.75		5.80	[d] 20.97

[a] Recovered in zinc residues.
[b] Lead recovered in zinc residues and leaded zinc oxide.
[c] Zinc recovered as zinc in zinc oxide.
[d] Assay of content; no deduction for loss in smelting.

Ores, slimes, and sands treated by amalgamation and cyanidation and gold and silver contained in bullion and precipitates in Colorado in 1924

Process	Material treated	Gold in bullion	Silver in bullion	Quicksilver used	Sodium cyanide used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	685,191	120,686.08	27,620	2,740	
Cyanidation	[a] 451,366	156,664.75	23,120		[b] 306,196
		277,350.83	50,740		

[a] Includes 182,176 tons of crude ore treated directly by cyanidation and duplicates 269,190 tons (in the form of sands and slimes) from ore treated first by amalgamation.
[b] Reduced to equivalent of 96 to 98 per cent content.

METAL INDUSTRY

The outstanding features of 1924 in the metal-mining industry of Colorado were: In the Cripple Creek gold district the improved financial condition of the Portland mine, the continued excellent condition of the Cresson gold mine, the increased production of the United Gold Mines Co., and the sinking of the long idle American Eagles shaft from 1,500 to 2,000 feet; in the Leadville lead-silver-gold-zinc district, the continued unwatering of the Graham Park-Carbonate Hill mines and the production of a very large quantity of high-grade gold ore at the Ibex mine; at Telluride, the improved financial condition and prospects for continued operation of the Smuggler Union and Tomboy mines, counterbalanced by the idleness of the Black Bear mine after March; at Eureka, the continuous operation of the Sunnyside lead-zinc mine; at Bonanza, the continued idleness of the Rawley mine; at Ouray and Aspen, the decline in production, owing to idleness of properties because of the lower average price received for silver after the expiration of the Pittman Act June 2, 1923; at Gilman, the continued development of zinc ore reserves by the Empire Zinc Co.; at Breckenridge, the idleness of the Wellington zinc mill after April; at Climax, the reopening of the molybdenum mine, idle since 1919; at Whitepine, the production of the Akron lead-zinc mines; at Ilse, the continued production of high-grade lead (cerussite) concentrates from the Terrible mine; and west of Silver Plume, the discovery of bodies of lead-silver-zinc ore.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1924

County	Producing mines	Ore sold or treated (short tons)	Metal content [a]			
			Gold [b]		Silver [b]	
			Fine ounces	Value	Fine ounces	Value
Adams	1		35.22	$728	6	$4
Boulder	36	2,625	1,097.05	22,678	15,936	10,677
Chaffee	5	881	414.67	8,572	9,667	6,477
Clear Creek	39	10,315	1,580.31	32,668	70,815	47,446
Custer	8	32,039	159.44	3,296	21,058	14,109
Dolores	4	562	20.32	420	9,918	6,645
Eagle	9	104,904	1,461.65	30,215	210,497	141,033
Gilpin	45	4,915	1,952.37	40,359	13,561	9,086
Gunnison	6	11,585	755.42	15,616	64,106	42,951
Hinsdale	7	1,038	26.70	552	16,776	11,240
Lake	50	165,593	47,414.95	980,154	519,460	348,038
La Plata	14	1,295	1,136.91	23,502	11,597	7,770
Mineral	7	4,647	72.27	1,494	239,149	160,230
Moffat	1		1.40	29		
Montrose	1		18.72	387	6	4
Ouray	7	23,447	659.11	13,625	166,345	111,451
Park	10	5,602	6,740.14	139,331	16,906	11,327
Pitkin	9	5,931			73,327	49,129
Rio Grande	1	15	172.12	3,558	109	73
Saguache	7	1,321	14.03	290	9,939	6,659
San Juan	13	233,790	19,557.19	404,283	689,656	462,070
San Miguel	13	433,411	79,048.04	1,634,068	994,139	666,073
Summit	22	25,521	14,289.30	295,386	73,321	49,125
Teller	43	444,745	239,064.65	4,941,905	28,076	18,811
Total, 1923	358	1,514,182	415,691.98	8,593,116	3,254,370	2,180,428
	417	1,569,100	318,870.05	6,591,629	5,334,488	4,374,280
Increase or decrease from 1923	−59	−54,918	+96,821.93	+2,001,487	−2,080,118	−2,193,852

County	Metal content [a]						Total value
	Copper		Lead		Zinc		
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$732
Boulder	931	$122	19,250	$1,540			35,017
Chaffee	22,870	2,996	162,775	13,022			31,067
Clear Creek	24,038	3,149	272,225	21,778	46,400	$3,016	108,057
Custer	2,282	299	2,147,537	171,803			189,507
Dolores	11,794	1,545	177,413	14,193	21,800	1,417	24,220
Eagle	357,733	46,863	2,289,612	183,169	22,132,000	1,438,580	1,839,860
Gilpin	26,534	3,476	165,375	13,230	13,400	871	67,022
Gunnison	1,465	192	3,285,538	262,843	3,710,600	241,189	562,791
Hinsdale	9,489	1,243	206,237	16,499			29,534
Lake	122,878	16,097	9,687,587	775,007	9,191,000	597,415	2,716,711
La Plata	488	64	387	31			31,367
Mineral			191,562	15,325	41,000	2,665	179,714
Moffat							29
Montrose							391
Ouray	9,763	1,279	811,413	64,913			191,268
Park	25,206	3,302	110,062	8,805	20,000	1,300	164,065
Pitkin			909,638	72,771	354,000	23,010	144,910
Rio Grande			1,600	128			3,759
Saguache	1,748	229	86,375	6,910	115,600	7,514	21,602
San Juan	1,601,748	209,829	17,559,913	1,404,793	17,579,000	1,142,635	3,623,610
San Miguel	494,252	64,747	7,262,325	580,986	278,000	18,070	2,963,944
Summit			2,210,237	176,819	3,224,200	209,573	730,903
Teller							4,960,716
Total, 1923	2,713,219	355,432	47,557,061	3,804,565	56,727,000	3,687,255	18,620,796
	4,248,109	624,472	45,698,185	3,198,873	54,152,000	3,682,336	18,471,590
Increase or decrease from 1923	−1,534,890	−269,040	+1,858,876	+605,692	+2,575,000	+4,919	+149,206

[a] In terms of metal recovered; figures are derived from individual mine reports, with allowances made for smelting recoveries and losses.

[b] Includes placer production, as follows: 1924, gold 20,245.23 fine ounces, $418,506; silver 4,954 fine ounces, $3,319; 1923, gold 17,629.25 ounces, $364,429; silver 4,122 ounces, $3,380.

REVIEW BY COUNTIES[1]

ADAMS COUNTY

A patented device for saving placer gold was attached to the tail-race of several road-gravel screening and washing plants in the bed of Clear Creek above and below Federal Boulevard; it recovered $732 of placer gold and silver in 1924.

BOULDER COUNTY

Central district.—The Central district, near Jamestown, produced 83 tons of ore, yielding $445 in gold, 915 fine ounces of silver, 931 pounds of copper, and 8,702 pounds of lead; total value of metal was $1,876, as compared with $1,533 in 1923. The production represented shipments from seven properties. The largest shipments were from the Maud S. and Violet Ray mines. Much of the above production was made in connection with a small production of fluorspar.

Gold Hill district.—The Gold Hill district produced 12 tons of ore, which yielded $564 in gold and 36 fine ounces of silver; total value of metal was $588, as compared with $3,067 in 1923. The production was made from nine properties.

Grand Island district (Cardinal, Caribou, Eldora, and Nederland).—The Grand Island district produced 58 tons of ore, yielding $606 in gold, 8,703 fine ounces of silver, and 5,987 pounds of lead; total value of metal was $6,916, as compared with $24,065 in 1923. The bulk of the output of the district was from the Caribou and the Potosi mines.

Magnolia district.—The production of the Magnolia district came from seven properties and aggregated 326 tons of ore, yielding $2,682 in gold. Most of the production was in concentrates made from milling the Keystone dump.

Sugar Loaf district.—The Sugar Loaf district continued to be the chief producing district in Boulder County, eight mines making in all an output of 2,144 tons of ore that yielded $18,326 in gold, 6,282 fine ounces of silver, and 4,561 pounds of lead, with a total value of $22,900, as compared with $27,868 for the output in 1923. The Logan, Yellow Pine, and Wood Mountain mines were the chief producers.

Ward district.—The Ward district produced 2 tons of ore, yielding $55 in gold, as compared with a total value of $2,671 for gold, silver, and lead in 1923.

CHAFFEE COUNTY

Chalk Creek district (Romley).—The Allie Bell and Mary Murphy mines made a total production of 401 tons of ore, yielding $8,006 in gold, 6,982 fine ounces of silver, 984 pounds of copper, and 49,500 pounds of lead; the total value of metal was $16,773, as compared with $34,441 in 1923.

La Plata district.—The Banner mine, southwest of Granite, shipped 3 tons of silver-lead ore, yielding $4 in gold, 282 fine ounces of silver, and 665 pounds of lead; the total value of metal was $246, as compared with $87 in 1923.

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[1] For production by counties see table, p. 557.

Monarch-Garfield district.—In the Monarch-Garfield district in 1924 only two mines were producing, the Lilly and the Madonna; they made an output of 477 tons of ore, yielding $562 in gold, 2,403 fine ounces of silver, 21,886 pounds of copper, and 112,610 pounds of lead, with a total value of $14,048, as compared with $46,295 in 1923.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—The Lombard mine produced 3,500 tons of ore, yielding $8,180 in gold, 727 fine ounces of silver, 1,023 pounds of copper, and 13,925 pounds of lead, with a total gross value of $9,915, as compared with a total value of $113 for the district in 1923.

Argentine district.—Two producing mines in the Argentine district—the Hamill Tunnel and Santiago—produced 369 tons of ore.

Empire district.—The Gold Dirt and Rifle mines produced 4 tons of ore, yielding $129 in gold, 6 fine ounces of silver, and 99 pounds of copper, with a total value of $146, as compared with $9,784 for the district in 1923.

Griffith district (*Georgetown, Silver Plume*).—Nine mines in the Griffith district produced 3,153 tons of ore, yielding $1,016 in gold, 19,236 fine ounces of silver, 127,438 pounds of lead, and 46,400 pounds of zinc; the total value of metal was $27,115, as compared with $145,383 in 1923. The 1924 production included small shipments of smelting ore and small lots of concentrates from experimental tests at the East Butte (Dives-Seven Thirty), Mendota, Sceptre, and Watrous (Mammoth) concentrating mills.

Idaho Springs district.—The Idaho Springs district from 15 mines produced 1,243 tons of ore, yielding $5,707 in gold, 10,373 fine ounces of silver, 2,680 pounds of copper, and 53,363 pounds of lead; the total gross value of metal was $17,277, as compared with $39,165 in 1923. Smelting ore amounted to 151 tons, milling ore 1,092 tons. The largest producing property was the Freighter's Friend.

Montana district (*Lawson, Dumont*).—The Montana district from 6 mines produced 537 tons of ore, yielding $327 in gold, 3,645 fine ounces of silver, and 30,448 pounds of lead, having a total gross value of $5,205, as compared with $25,589 in 1923. The Bellevue-Hudson and the Jo Reynolds concentrating mills were active for short periods.

Trail Creek district (*Lamartine, Freeland*).—The Trail Creek district produced 1,509 tons of ore. There were four producing mines; the Freeland, the chief producer, shipped smelting and milling ore.

CUSTER COUNTY

Hardscrabble district.—Three producing mines—the Black Friday, Last Quarter, and Passiflora—produced 498 tons of ore, yielding $388 in gold, 18,800 fine ounces of silver, 2,145 pounds of copper, and 73,925 pounds of lead; the total value of metal was $19,179, as compared with $28,603 in 1923.

Oak Creek district.—The Terrible mine was the only producer in this district, with an output of 30,000 tons of cerussite ore, from which the concentrating mill on the property made 1,500 tons of 69 per cent lead concentrates.

Rosita Hills district.—Four mines in the Rosita Hills district produced 1,541 tons of smelting and milling ore, from which was

recovered $2,908 in gold, 2,258 fine ounces of silver, 137 pounds of copper, and 3,612 pounds of lead; the total gross value of metal was $4,728, as compared with $4,627 in 1923. The new cyanidation mill on the Bassick dump was in operation several months.

DOLORES COUNTY

Dolores County produced, from the Emma mine at Dunton and the C. V. G., Nora Lilly, Falcon, Yellow Jacket, and Western No. 7 mines in the Rico district, 562 tons of smelting ore, yielding $420 in gold, 9,918 fine ounces of silver, 11,794 pounds of copper, 177,413 pounds of lead, and 21,800 pounds of zinc; the total value of metal was $24,220, as compared with $64,311 in 1923.

EAGLE COUNTY

Battle Mountain district (Red Cliff, Gilman).—Eight producing properties in the Red Cliff district, chief of which were the Eagle mines of the Empire Zinc Co., mined 104,832 tons of ore, yielding in recovered content of smelting ore and concentrates $30,215 in gold, 207,549 fine ounces of silver, 357,474 pounds of copper, 2,289,612 pounds of lead, and 22,132,000 pounds of zinc; the total value of metal was $1,837,851, as compared with $2,035,890 in 1923. Other producing mines were the Ben Butler, Foster Combination, Ground Hog, Pursey Chester, Silver Dollar, Sulphide, and Wyoming Valley.

Brush Creek district.—Lessees on the North Dakota-Lady Belle group shipped 72 tons of dry silver smelting ore.

EL PASO COUNTY

At Colorado Springs the Golden Cycle 1,200-ton roast-amalgamation and cyanidation mill ran steadily, but not at full capacity; it chiefly treated gold ores from the Cripple Creek district and small lots of gold ore from Boulder County. The Cresson mine in the Cripple Creek district continued to contribute about half of the ore treated at the Golden Cycle mill.

FREMONT COUNTY

At Canon City the Empire Zinc Co.'s magnetic separation plant steadily treated zinc-iron sulphide ore from its Eagle mines at Gilman, Eagle County, and its zinc oxide plant handled concentrates from Hanover, N. Mex., and some zinc carbonate ore from Leadville. At Florence the River Smelting & Refining Co.'s matting and fuming plant treated lead-zinc ores from Colorado and Utah.

GILPIN COUNTY

Southern districts (Black Hawk, Central City, Nevadaville, Russell Gulch).—The southern districts of Gilpin County produced 3,126 tons of ore, yielding $36,205 in gold, 13,288 fine ounces of silver, 24,618 pounds of copper, 151,725 pounds of lead, and 13,400 pounds of zinc; the total value of metal was $61,342, compared with $79,438 in 1923. The production in 1924 comprised small lots of bullion, concentrates, and smelting ore from 38 mines. The most important producers were the Ætna Tunnel, Bryan Tunnel, Eureka, Jennie Blanche, Jupiter-Belmont, and Old Town and Senator.

Northern districts.—The northern districts produced 1,789 tons of ore, yielding $4,154 in gold, 273 fine ounces of silver, 1,916 pounds of copper, and 13,650 pounds of lead; the total value of metal was $5,680, as compared with $5,952 in 1923. Producing mines were the Penobscot, Perigo, Philadelphia, Reform, and Smuggler.

GUNNISON COUNTY

Elk Mountain district.—The Burlington Mines Co. of Crested Butte shipped a car of siliceous silver ore.

Gold Brick district (Ohio City).—From the Carter mines and a small output from the Dodson mine the Gold Brick district produced 1,536 tons of ore, which yielded $12,777 in gold, 3,203 fine ounces of silver, and 4,463 pounds of lead; the total gross value of metal was $15,280, as compared with $27,078 in 1923.

Quartz Creek district (Pitkin).—At the Roosevelt mines a test run on 100 tons of gold ore was made in the amalgamation mill on the property.

Tomichi district (Whitepine).—From the Akron group and the Victor mine 9,928 tons of zinc-lead sulphide and lead oxide ores were shipped to various custom smelters under various contracts. The total gross calculated value of the estimated recovered metals was $546,824, compared with $331,432 in 1923.

HINSDALE COUNTY

Galena district.—The output of five producing mines in the Galena district (with the Lellie the chief producer) amounted to 954 tons of ore, yielding $442 in gold, 8,782 fine ounces of silver, 3,374 pounds of copper, and 199,138 pounds of lead; the total value of metal was $22,699, as compared with $28,249 in 1923.

Lake district.—The Belle of the West and the George III mines in the Lake district produced 84 tons of ore, yielding $110 in gold, 7,994 fine ounces of silver, 6,115 pounds of copper, and 7,099 pounds of lead, with a total value of $6,835.

LAKE COUNTY

In Lake County the gross value of the five metals considered in this report increased from $1,918,489 in 1923 to $2,716,711 in 1924. Gold showed an increase of $708,650, silver decreased $189,749, copper decreased $59,134, lead increased $381,260, and zinc decreased $42,805. The total quantity of ore shipped increased from 115,975 tons in 1923 to 165,593 tons in 1924. Lake County ranked second in the production of lead, third in the production of gold, third in the production of silver, third in the production of zinc, and fourth in the production of copper.

LEADVILLE DISTRICT

GENERAL FEATURES

Of the 165,593 tons of ore mined in Lake County in 1924, 162,760 tons came from the Leadville district. The yield was $952,425 in gold, 495,348 fine ounces of silver, 121,855 pounds of copper, 9,590,212 pounds of lead, and 9,122,000 pounds of zinc, and the total calculated value of the metals was $2,660,418, out of a county total of $2,716,711.

Classification of Leadville ores in 1924

	Ore		Recovered content				
	Per centage	Short tons	Gold	Silver	Copper	Lead	Zinc
			Fine ounces	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Sulphide:							
Siliceous (carrying sulphides) [a]	1	2,212	588.30	16,622	23,535	144,756	
Iron pyrites [b]	21	34,150	9,648.60	22,149	24,215	34,047	
Lead	2	3,032	316.70	27,308	655	521,484	
Copper (mostly excess silica)	1	1,147	823.90	19,396	62,935	22,806	
Zinc-iron-lead	7	11,599	[c] 647.50	[c] 46,321		[d] 1,546,164	[e] 3,326,000
	32	52,140	12,025.00	131,796	111,340	2,269,257	3,326,000
Oxide (includes low-sulphur ores):							
Siliceous gold	1	2,095	26,852.54	15,644	6,798	65,969	
Silver (mostly old slags)	38	61,408	.90	204,501		3,408,791	
Lead (iron excess)	2	4,335	46.60	19,033	157	683,047	
Lead (silica excess)	11	18,954	1,484.50	91,825	3,560	2,967,086	
Iron-manganese-silver-flux	5	5,027	8.90	31,084		196,062	
Zinc	11	18,801					[e] 5,796,000
	68	110,620	28,393.44	362,087	10,515	7,320,955	5,796,000
Metal (sulphide and oxide)			5,655.12	1,465			
	100	162,760	46,073.56	495,348	121,855	9,590,212	9,122,000

	Average recovery				
	Gold	Silver	Copper	Lead	Zinc
	Ounces per ton	*Ounces per ton*	*Per cent*	*Per cent*	*Per cent*
Sulphide:					
Siliceous (carrying sulphides)	0.266	7.51	0.53	3.27	
Iron pyrites	.283	.65	.04	.05	
Lead	.104	9.01	.01	8.60	
Copper (mostly excess silica)	.718	16.91	2.74	.99	
Zinc-iron-lead	.056	3.99		[f] 7.96	[f] 19.45
Oxide:					
Siliceous gold	12.817	7.47	.16	1.57	
Silver (mostly old slags)		3.33		2.78	
Lead (iron excess)	.011	4.39		7.88	
Lead (silica excess)	.078	4.85		7.83	
Iron-manganese-silver-flux	.002	6.18		1.95	
Zinc					[f] 19.56

[a] Much highly siliceous, and in all silica exceeds iron content. Partly gold and partly silver ore.
[b] Iron content exceeds silica content. A dry silver ore.
[c] Recovered in residues.
[d] Recovered in residues and in leaded zinc oxide.
[e] Zinc in terms of recovered zinc in zinc oxide and leaded zinc oxide.
[f] Average assay of original content; no deduction for loss in smelting. Wet assay of lead.

The A. V. lead bullion and copper matte smelter of the American Smelting & Refining Co., with 8 furnaces, ran 3 furnaces throughout the year and 4 furnaces part of the year on Colorado ores and concentrates and some Utah lead sulphide ores. Old slags from the old American, Bi-Metallic, Elgin, Grant, and Harrison smelter dumps, containing lead and silver, helped maintain the smelter operation. The Western zinc oxide plant, using Leadville low-grade zinc oxide ores entirely, was in continuous operation.

MINES REVIEW

The pumps at the Penrose mine were pulled on October 31, 1923, but some lead oxide (iron excess) ore was mined from the upper levels before the water rose in the shaft. At the Greenback shaft, where

the Leadville Deep Mines Co. had started pumping late in September, 1923, the water level by December 31, 1924, had been lowered from an elevation of 10,080 feet (or 550 feet below the collar of the shaft) to an elevation of about 9,300 feet (or 1,330 feet below the collar of the shaft). No mining was done in 1924 by the Leadville Deep Mines Co., but the lowering of the water permitted leases to be granted on the Brookland, Moyamensing, and Mahala claims, from which some lead oxide (iron excess) ores were mined.

The outstanding feature of the mining industry at Leadville in 1924 was the production from the Ibex mine of $130,000 of specimen gold and a car of high-grade smelting ore carrying 831 ounces of gold to the ton. In addition, this mine shipped 1,800 tons of siliceous oxide ore carrying nearly 5 ounces of gold to the ton; both iron and siliceous sulphide ores carrying gold and silver, with some copper and lead; also lead-zinc sulphide and zinc carbonate ores. Moreover, the coarsely disseminated pyrite ore body of the southern claims of the Ibex Co. was milled at the Leadville district gravity-concentration mill, yielding pyrite concentrates that carried gold.

The output of lead sulphide, lead oxide, and lead-zinc sulphide ores from the Yak mines was less than in 1923. The Fanny Rawlings mine shipped siliceous copper sulphide and iron-copper sulphide ore carrying silver and gold.

A fairly large quantity of lead oxide (silica excess) and iron-manganese-silver oxide ore was shipped from the Henriett-Maid of Erin mine and lead oxide (silica excess) from the Stars group. Crude sulphide (silica excess) ore was shipped from the A. Y. and Minnie dump, several cars of iron sulphide ore from the Louisville, lead sulphide and lead-zinc sulphide ore from the Pittsburg, lead oxide (silica excess) from the Iszard, St. Louis Tunnel, and Luema; lead-zinc sulphide ore from the Fortune and from lessees' operations on the Iron Silver group; and many small lots of various grades from other mines. Mines that shipped zinc carbonate ore were the A. Y. and Minnie, Chrysolite, New Denver City, Henriett, Ibex, Tucson, Dome, Mahala, Greenback, Little Pittsburg, Robert E. Lee, Little Sliver, and Yak.

Several cars of lead oxide (silica excess) ore were shipped from the Little Alice (Two Mile High Co.), in Iowa Gulch.

OTHER DISTRICTS

Alicante, Colorado Gulch, St. Kevin, and Sugar Loaf districts.—Five mines produced 2,833 tons of ore, yielding $4,276 in gold, 23,770 fine ounces of silver, 1,023 pounds of copper, 97,375 pounds of lead, and 69,000 pounds of zinc, having a total value of $32,611, as compared with $52,743 in 1923. Producers were the Gertrude and Pott mines, in Colorado Gulch; the Fanchon mine, in the Sugar Loaf district; the Griffin mine, in the St. Kevin district; and the John Reed mine, in the Alicante district.

Climax (Tenmile district).—In August the Climax molybdenum mine at the head of Tenmile Creek, idle since 1919, was reopened and the flotation mill was started at half capacity.

Placer mines.—The Derry Ranch dredge, with 80 buckets of 5 cubic feet, ran from May 2 to November 10, in Box Creek, below

Malta. Several sluicing operations at Granite produced a small quantity of placer gold.

LA PLATA COUNTY

The gold production from La Plata County mines increased in 1924, but copper, silver, and lead production decreased. There were 13 producing mines in the California district and one producing mine in Cave Basin district which yielded in all 1,295 tons of ore, $23,502 in gold, 11,597 fine ounces of silver, 488 pounds of copper, and 387 pounds of lead, with a total calculated gross value of $31,367, compared with $30,204 in 1923. The chief producing mines were the Mayday, Jumbo, and Southern Boy.

MINERAL COUNTY

The output of silver from Mineral County mines (all near Creede) increased in quantity but decreased in value. There was decreased output of gold and lead, no output of copper, and no change in quantity of zinc produced, but a decrease in the value of the zinc. The chief producing mines were the Amethyst, Bachelor, Commodore, and New York-Last Chance-Volunteer group.

MOFFAT COUNTY

Placer production averaging 0.951 in fineness of gold was marketed from placers in the Fourmile Creek region.

MONTROSE COUNTY

Placer gold, averaging 0.795 in fineness of gold and 0.202 in fineness of silver, from the sluicing of bench gravel was marketed from the La Sal mining region.

OURAY COUNTY

Red Mountain district.—Two mines in the Red Mountain district—the Barstow and the William Penn—produced 278 tons of ore yielding $2,863 in gold, 991 fine ounces of silver, 2,100 pounds of copper, and 10,413 pounds of lead; the total value of metal was $4,635, as compared with $2,248 in 1923.

Sneffels district.—The Atlas mine, the only one active in the Sneffels district in 1924, produced 23,049 tons of ore that yielded metals with a total calculated gross value of $179,252, as compared with $848,581 for the district in 1923.

Uncompahgre district.—Four mines in the Uncompahgre district—the American Nettie, Bright Diamond, Eva, and Last Day—produced 120 tons of ore, yielding $3,279 in gold, 4,609 fine ounces of silver, 1,152 pounds of copper, and 10,788 pounds of lead; the total gross value of metal was $7,381, as compared with $11,373 in 1923.

PARK COUNTY

Buckskin district.—Placers produced gold bullion averaging 0.807 in fineness of gold and 0.173 in fineness of silver. Four deep mines—the Excelsior, the Home Sweet Home, Little Fanny, and Sloan—produced 305 tons of ore, yielding metals with a total calculated gross value of $22,001, as compared with $33,304 for the district in 1923.

Fairplay district.—The dredge of the South Park Dredging Co., in operation from May 21, 1922, through 1923 in the stream bed of the South Platte River, below Fairplay, ran in 1924 from March 26 to December 31. The dredge has 72 buckets of 9 cubic feet each, and the daily capacity in 24 hours is 4,650 cubic yards.

Hall Valley district.—The La Clede-Missouri mine, in the Hall Valley district, shipped 23 tons of ore, yielding $122 in gold, 1,127 fine ounces of silver, 2,557 pounds of copper, and 1,380 pounds of lead, valued in all at $1,322. The ore of this mine has in the past carried bismuth.

Mosquito district.—The Edna and London mines, in the Mosquito district, produced 5,274 tons of ore, yielding $21,959 in gold, 2,455 fine ounces of silver, and 34,869 pounds of lead, with a gross calculated value of $26,394. Part of the output from the London mine was in the form of bullion from the 60-ton cyanidation mill built in North Mosquito Gulch, 1923–24, by the London Mines Leasing Co., and part was from company shipments of lead-gold smelting ore.

PITKIN COUNTY

Production in Pitkin County in 1924 decreased by approximately 356,000 ounces of silver, 2,000,000 pounds of lead, and 100,000 pounds of zinc. The producing mines were the Aspen Fraction, Della S., Spar Consolidated, Bonny Bell, Hope, Last Dollar, Midnight, Newman Tunnel, and the Lenado property of the Smuggler Leasing Co. The only producing district was the Aspen, with an output of 5,931 tons of ore yielding 73,327 fine ounces of silver, 909,638 pounds of lead, and 354,000 pounds of zinc, valued in all at $144,910, as compared with $591,959 in 1923. The Smuggler Leasing Co.'s concentration mill was idle all year. The company's properties and the Cowenhoven adit were under option by the Aspen Mines Co., which repaired 9,000 feet of adit and drove 2,000 feet of new raises and crosscuts.

RIO GRANDE COUNTY

Summitville district.—A car of gold ore, having a high content of gold and carrying some silver and lead, was shipped from the Miser-Guadalupe group.

SAGUACHE COUNTY

The Rawley mine and mill at Bonanza were idle in 1924. A 50-ton gravity-concentration and oil-flotation mill was completed at the Cocomongo-Bonanza mine in May, 1924, and ran for several months, producing lead and lead-zinc concentrates. A car of silver ore, with siliceous gangue and iron and manganese oxides, was shipped from the Royal Coachman mine and several cars of similar ore from the Essie mine. The Erie and St. Louis mines each shipped a car of lead-zinc sulphide ore.

SAN JUAN COUNTY

Animas district.—Nine mines in the Animas district, in the vicinity of Silverton, produced 2,786 tons of ore, yielding $4,695 in gold, 19,815 fine ounces of silver, 33,832 pounds of copper, and 395,575 pounds of lead, with a total calculated gross value of $54,049, as com-

pared with $89,267 in 1923. Producing mines were the Aspen, Highland Mary, Little Dora, Little Fanny, Little Nation, North Star, Old Green Mountain, Old Hundred group, and Pride of the West.

Eureka district.—Producing mines in the Eureka district north of Silverton were the Mountain Queen, Gold King, Eureka, Silver Queen, and Sunnyside. The Sunnyside lead-zinc mine, with its 500-ton selective flotation mill, was in operation 365 days.

SAN MIGUEL COUNTY

The gold production of San Miguel County mines increased $260,100, but silver, copper, and lead production decreased. Zinc recovered in 1924 amounted to 278,000 pounds; none was produced in 1923.

Iron Springs district (Ophir).—The Butterfly-Terrible, Carbonero, Deadwood, San Bernardo, and Silver Bell mines in the Ophir district produced 562 tons of ore, yielding $697 in gold, 10,194 fine ounces of silver, 6,679 pounds of copper, and 100,925 pounds of lead, with a gross total value of $16,476. A 50-ton flotation mill was completed at the Carbonero mine in November.

Upper San Miguel district (Telluride).—Eight mines in upper San Miguel district produced 432,849 tons of ore, yielding $1,633,371 in gold, 983,945 fine ounces of silver, 487,573 pounds of copper, 7,161,400 pounds of lead, and 278,000 pounds of zinc, with a total value of $2,947,468, compared with $3,531,906 in 1923. Activities of the Belmont Wagner Mining Co. (Tonopah Belmont Development Co.) at the Alta mine were confined to driving the Black Hawk adit for development. Late in the year this company relinquished its option, and the mill was run for a short period by the original owners. The Smuggler Union mine was in operation 363 days. The mills of this company, a 60-stamp amalgamation-concentration mill and an 850-ton flotation plant, were used to treat the Smuggler Union and Black Bear ore. The Smuggler Union ore was first amalgamated, but the Black Bear ore was first run over tables to make a high-grade lead product, and the overflow went to the flotation machines, which made a zinc-lead-copper-iron-silver-gold concentrate. This complex concentrate was then moved to Durango for storage and treatment at the Reed-Coolbaugh sulphating and leaching plant at the Durango smelter, where the zinc was first removed and the roasted and leached material was sent to the lead furnaces. A market was found in 1924 for the zinc sulphate made. The Black Bear mine ran less than 90 days in 1924, but the Reed-Coolbaugh plant continued to treat stored concentrates. Lessees of the Liberty Bell mine produced some gold amalgam bullion and some gold concentrate. The Tomboy Co. mine and 600-ton flotation mill was in operation 363 days. The annual report of the Tomboy Gold Mines Co. (Ltd.) for the year ended June 30, 1924, containing the report of the manager, dated July 15, 1924, says:

> A total gross of 236,353 tons was hauled from the mines to the mill. From this total 9,551 tons, or 4.04 per cent, were sorted out at the mill and discarded as waste, and 11,006 tons, or 4.85 per cent, were deducted for moisture content, leaving, with a gain in bin storage of 198 tons, a net total of 215,598 dry tons milled. A total of 22,029 wet tons, or 9 per cent of the tonnage sent to the mill, were drawn from the Argentine.

Beginning with September, 1923, all drawing of ore from above 1,750-foot level was discontinued for the reason that the ore remaining, both broken and unbroken, was too low grade to produce a profit. At the time of abandoning the upper Argentine levels a considerable tonnage of broken and unbroken ore still remained below the 1,750-foot level, but the lower part of the mine was filled with water, stored for milling purposes during the dry season. During January, 1924, when the level of the stored water had been lowered below the 1,900-foot level, 640 tons of ore were drawn from a length of stope a little over 2,000 feet and milled. A careful record of this mill test showed this ore to be of profitable grade, but later during March and April, when over 3,000 tons were drawn and milled, the grade dropped far below the mill test results. The only plausible explanation for this condition is that the first sampling drew off a large proportion of rich fines that had been washed down to the chute mouths by the water flowing through the stope. Since this last drawing of ore the Argentine has been entirely abandoned.

Development driving in the Montana proper totaled 496 feet and consisted of the completion of the foot wall drift south to No. 107 chute on 1,750-foot level, by driving an additional 183 feet, crosscutting 19 feet into the footwall opposite No. 128 raise, for a hoist station; raising into the old empty stope from this hoist station a distance of 60 feet, for an ore pocket, head sheave, and dump; and the extension of the 1,750-foot level drift on the Montana vein north of the Sidney, a distance of 141 feet, together with 93 feet of crosscutting from this drift.

This last drifting and crosscutting thoroughly explored the northern extension of the Montana vein opening to a distance totaling a little over 600 feet north of the Sidney. The showing became weaker and less encouraging as the drift was advanced, and all further development in this direction was finally abandoned.

A year ago it was expected that sufficient work would have been completed by the first of this year to enable drawing some ore from below the 1,750-foot level through No. 128 hoistway, but many unforeseen conditions were encountered and it will still be several months before any ore will even be available from the 1,900-foot stopes.

A total of 200,646 wet tons, or 85 per cent of the tonnage sent to the mill, were drawn from the Montana.

Development driving in the Montana (Virginius) totaled 426 feet, and consisted of the completion of a winze for a distance of 98 feet to the 1,900-foot level, a crosscut from the bottom of the winze to the vein, a distance of 19 feet, a drift on the vein for a distance of 296 feet, and a footwall crosscut off this drift a distance of 13 feet.

This drift on the 1,900-foot level explored the vein at this elevation vertically below the best part of the ore shoot on 1,750-foot level. It had been hoped that as the Virginius ore body did not extend above the 1,450-foot level it might improve at further depth, or at least continue to the 1,900-foot level. However, as the drift on the 1,900-foot level, in the most likely section, did not disclose any profitable ore, further development in this territory was abandoned.

Further stoping was carried on in that portion of the ore shoot lying between No. 26 raise and No. 35 chute from 1,750 to 1,450 foot levels, as shown on the progress sheet for the year, and stoping was only discontinued when the value of the ore, containing silver alone, became too low to pay to mine and mill. Just at this time, also, the gold values which, in the total run of mine, had been gradually decreasing as the best gold shoots were exhausted, reached a startlingly low point that would allow of no dilution by just medium-grade ore containing silver only. Therefore, further drawing of Virginius ore was also stopped and this section of Montana has been drawn on only occasionally since then, when better gold values from other parts would allow some dilution by silver ore.

A total of 13,677 wet tons, or 6 per cent of the tonnage sent to the mill, were drawn from the Virginius.

The total ore reserves stand, as of July 1, 1924, at 215,602 tons total, and are composed of 125,725 tons of broken ore and 89,877 tons of unbroken ore.

Of this tonnage 9,675 tons of broken ore remain in the 35 to 50 block, 13,500 tons in the 101 block, 70,275 tons in the 147 to 167 block, 14,625 tons north of No. 167, and 17,650 tons below the 1,750-foot level. Of unbroken ore 14,000 tons remain to be stoped north of No. 167, above the 1,750-foot level, and 75, 877 tons below the 1,750-foot level.

In arriving at a new estimate of ore remaining to be mined, drawn, and milled, only the ore in the Montana is dealt with, as there is but slight possibility of

being able to treat profitably any further ore from the Argentine or Virginius veins.

In estimating the above tonnage the original average width of vein is used and no account is taken of the waste wall rock that has caved into the ore or may still cave into it. This caving may prove to have increased the total tonnage to a very considerable extent, but, on the other hand, such caving may also prove to have so diluted the ore values in some sections as to render them unprofitable to mill. As has been previously explained, just what conditions exist can only be determined as the stopes are drawn and milled.

One considerable block of broken ore (that from No. 1 to No. 35 chute above 1,750-foot level) has been omitted from the estimate entirely, as it is known to be too low grade to pay, but offsetting this, 22,500 tons of very probable ore that we should be able to reach from the south end of 1,900-foot level, lying between our 1,750-foot level and the top of the old Revenue workings, have been included.

The mill has been maintained in first-class operating condition throughout the year, but no additions have been made and only a few minor improvements.

During the annual dry season water for milling became quite scarce, but the spring thaw started just when the water in the Argentine became exhausted, so that it was possible to maintain a fairly good tonnage milled throughout the 12 months.

This last spring further cleaning up of the old 60-stamp mill site has been resumed under lease.

Revenue and expenditure, year to June 30, 1924

215,598 dry tons milled, yielding bullion worth			$176,232
Concentrates worth			579,185
			755,417
Sundry profit, boarding house, rents, etc			5,660
Royalty (from lessees)			3,333
			764,410
	Per ton		
Mining and development expenses	$1.38	$296,603	
Milling expenses	.59	126,883	
Concentrating expenses (including transportation to railway)	.60	130,354	
Water supply expenses	.16	36,138	
Assay office expenses	.03	6,351	
General expenses	.27	58,307	
Taxes and insurance	.16	34,270	
Total expense	3.19		688,906
Profit			75,504

During October, 1923, after having operated for two months at a loss, the outlook for the future of the mines became very discouraging; it did not seem likely that the few remaining possibilities could pull us through, and all indications pointed to even poorer times ahead. You were therefore fully advised at that time and the situation put before you in its worst possible light. Shortly thereafter, however, conditions commenced to improve, principally because of some better ore becoming available, and to date the position has been quite comfortable. As most of the ore we were relying upon to maintain our gold heads has been gradually exhausted and the gold heads have remained up, we are led to believe that there is more gold in the ore lying to the north of No. 147 chute than had been hoped for. We are still not far enough north of the Wheel of Fortune crossing though to assume that the gold values will continue as they are until the No. 147–No. 167 block is exhausted. If we should be fortunate enough to maintain mill heads at a point high enough to continue making a profit on the total tonnage named under "Ore reserves," we should be able to continue operations for a little over a year longer, and this time will be added to by any increased tonnage from caving walls so long as the dilution of ore values is not too great.

During the past year operating costs have been still further reduced to a new low cost record. This was made possible by eliminating almost all development work; concentrating all other underground work; improved cooperation between all staff members and other workers; obtaining a more advantageous treatment schedule from the smelter and lower freight rates from the railroad; reducing the mine staff; eliminating the pay-roll bonus to men working 28 days per month, and the consolidating of the two offices by moving the town office to the mine. Some of these changes have not been in effect long enough to have their full

effect very noticeably reflected in the cost sheet, and the benefit of some extensive tax reductions will not be felt until later this year, so we may look for still further reductions in total costs during the year 1924–25.

At this date all indications point to at least another year of profitable operation, but with the underground conditions complicated by so many uncertainties no positive forecast is possible.

SUMMIT COUNTY

Breckenridge district.—The value of the metal output of the Breckenridge district from both deep and placer mines was $716,507, as compared with $1,074,932 in 1923. The Wellington gravity-concentration and magnetic-separation mills were operated until June 16, when development work only was done at the mine. Other producing deep mines were the Detroit-Hicks-Missouri group, New Era, Royal Tiger, and Silver King.

Two dredges, two hydraulic mines, and one sluice mine were in operation during the year. The Bemrose-Bostwick hydraulic placer was worked from June 1 to July 30. The Mekka bench gravel was hydraulicked from June 1 to September 15. The Blue River Placer Mining Co.'s dredge of 88 buckets of 8 cubic feet capacity each, on Blue River, was in operation from January 1 to December 25. The Tonopah Placers Co. ran its dredge *No. 1*, equipped with buckets of 9½ cubic feet capacity, for 198 days. The annual report of the Tonopah Mining Co., of Nevada, includes the following report of the activities of the Tonopah Placers Co.:

Production and income statement of Tonopah Placers Co. for the year 1924

Surplus, Dec. 31, 1923		$7,480.11
Net earnings and income for year 1924:		
Gross value of bullion shipped to mint	$164,217.45	
Cost of operations	119,367.26	
Profit from operations	44,850.19	
Other income	4,667.00	
Net income for the year 1924		49,517.19
		56,997.30
Reserves for the year 1924:		
Depletion of mineral property	$4,315.23	
Depreciation of plant and betterment	9,396.31	
Depreciation of dredge *No. 1*	3,186.80	
		16,898.34
Surplus, Dec. 31, 1924		40,098.96
Cubic yards dredged		1,141.140
Gold produced	ounces	7,877.77
Silver produced	do	2,022.64
Value per yard		$0.143

Balance sheet of Tonopah Placers Co., December 31, 1924

ASSETS

Property, plant, and betterment	$1,313,654.80
Dredges	187,230.58
Materials and supplies	47,129.53
Accounts receivable	2,125.43
Cash	75,288.24
Philadelphia Electric Co. first lien and refunding mortgage, gold 5½ per cent bonds, series due 1953	14,775.00
Baltimore & Ohio R. R. Co. first mortgage 5 per cent bonds, due 1948	24,625.00
	1,664,828.58

LIABILITIES

Capital stock, authorized and issued	1,000,000.00
Accounts payable	2,567.90
Reserve for depletion of property and depreciation of plant and equipment	472,452.94
Reserve for dredges *Nos. 1, 2,* and *3*	149,708.78
Surplus	40,098.96
	1,664,828.58

In September, 1922, the company, upon the recommendation of the engineer then in charge of the company's operations, acquired the Tonopah Ajax Mining Co.'s property at Victor, Colo.

The recommendation was based largely upon the undeveloped territory in the northern end of the property, along the contact between the granite and the breccia. This area was well developed near the surface and there disclosed many rich veins. As a result of this superficial development, and the fact that there was a shaft 2,000 feet in depth, together with a well-appointed plant which could be advantageously utilized to cheaply develop the aforementioned territory at depth, the property was obtained.

Over a period of 23 months 12,011 feet of development was performed. Although considerable valuable ore was obtained, this development work not proving as satisfactory as anticipated, it was decided to suspend operations.

Montezuma district.—Four mines—the Adder, Ida Bell, Jerry, and Saints John—produced 237 tons of ore, yielding $117 in gold, 4,821 ounces of silver, 107,074 pounds of lead, and 38,200 pounds of zinc, with a total value of $14,396, as compared with $26,467 in 1923.

TELLER COUNTY

Mine and dump ore, slags, slimes, concentrates, and stolen bullion from the Cripple Creek district aggregated in recovered gold to United States mints and to custom smelters 239,064.65 ounces, valued at $4,941,905, as compared with $4,047,008 in 1923, and in silver 28,076 fine ounces as compared with 22,606 ounces in 1923. The Golden Cycle mill, at Colorado Springs, a roast-amalgamation and cyanidation mill with a daily capacity of 1,200 tons, was in operation steadily at about half capacity, treating ores from the Cripple Creek district only, with the exception of several hundred tons of gold ore from Boulder County.

In the Cripple Creek district the Portland Gold Mining Co.'s Independence cyanidation and concentration mill, which has a capacity of 700 tons in 24 hours, handled 481 tons a day. Operation of the Independence mill showed the following results, according to the annual report of the Portland Gold Mining Co. for the calendar year 1924:

Source of input	Dry tons	Gross value	Average value per ton
Independence chute	24,542	$68,799	$2.80
Independence bin No. 1	162	242	1.49
Independence dump	228	678	2.97
No. 2 raise	43,455	199,590	4.59
Queen No. 2	9,704	21,206	2.19
Queen No. 3	5,463	10,185	1.87
Queen No. 4	75,966	438,695	5.76
Kurtz & Gray	1,089	2,133	1.96
No. 1 raise Basalt	1,196	3,457	2.88
500 and 600 No. 1 raise Granite	2,640	18,249	6.91
1,100 Basalt	31	68	2.20
No. 1 raise Scranton	16	39	2.40
	164,492	763,341	4.64
Portland lessees	1,384	12,556	9.07
Total company and lessees	165,876	775,897	4.67
Outside ore including Dexter dump	9,802	32,565	3.32
	175,678	808,462	4.60
High grade from melt house only		28,716	
Total input		837,178	

Recovery of bullion	$546,300
Concentrates shipped	128,843
	675,143
Value of input as above	837,178
Total recovery as above	675,143
Tailings loss for the year	138,310
	813,453

indicating an error in estimated recoverable values for the year of $23,726, most of which can be accounted for in the difference in the quantity and value of circulating solution at the beginning and end of the year and variations from the factor used in estimating the tonnage delivered into the mill.

The tailings loss for the year was 78.73 cents per ton, which was greater by 10.73 cents than 1923, but was materially less in proportion to the value of the head.

The average extraction on all ore handled during the year was 80.64 per cent as against 79.96 per cent in 1923. During that year the mill ore averaged $3.22 per ton.

The mine and mill were operated at the following expense:

Operating expense at Portland mine		$533,231
Operating expense at Independence mine		25,273
Operating expense at Independence mill (including marketing of concentrates)		264,870
Ore, freight, and trucking expense at mill		26,238
Royalties and treatment charges on lessees' ore		164,550
Tailings loss		138,310
		1,152,472
Total production as above	$1,490,459	
Miscellaneous earnings, mine and mill	6,960	
		1,497,419
Less expense		1,152,472
Gross profit on operations		344,947

MINES REVIEW

In Poverty Gulch over 1,000 tons of ore were shipped from the El Paso-Gold King mine.

On Tenderfoot Hill several thousand tons of ore were shipped from the Black Diamond claim of the Sangre De Christo Tunnel group by the Reclamation Metal Mining Co.

On Globe Hill lessees from the Stratton estate shipped several lots of ore from the Deerhorn dump and other dumps.

On the north slope of Ironclad Hill the producing mines were the Axtel, Forest Queen, Jerry Johnson, Pride of Cripple Creek, the Hardwood (or Damon) group, and W. P. H.

On Gold Hill there were no producing mines.

Shipping of the dump of the Economic mill, at the foot of Squaw Mountain, continued intermittently through 1924.

On Raven and Guyot hills the producing mines were the Cresson, Doctor-Jackpot, Elkton, and Mary McKinney. The Cresson mine continued to be the mainstay of the Golden Cycle mill. Shipments were made at the rate of 10,000 tons a month.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended August 31, 1924 (dated November 30, 1924), says:

During the year 123,205 dry tons of ore were shipped of a gross value of $2,001,458, averaging $16.24 per ton; the returns, less transportation and treatment, were $1,314,872, giving the ore a net value of $10.67 per ton. The company received as additional income the sum of $12.63, being net royalties from 65 tons of ore shipped by lessees, and also $15,883 interest on bank deposits, making a grand total of $1,330,767, with total expenses of $649,814, resulting in a net gain from operations of $680,954. The total cost per ton of ore produced

was $5.27. This is an increase of 34 cents per ton over 1923, but our broken ore reserve is much larger than a year ago.

You will note in our company's production of 123,205 dry tons, with an average return of $10.80 per ton, our entire cost was $5.27 per dry ton, resulting in a net profit of $5.53 per ton.

Total cash at the close of the fiscal year ending August 31, 1924, was $992,090.

The total cost of mining is divided as follows:

General expense	$0.023
Taxes	.26
Insurance	.102
Salary officers	.068
Colorado Springs office	.081
Mining operations (includes mine management and engineering)	4.738
	5.27

The broken ore reserve again substantially exceeds that at the end of the previous fiscal year, and exploration and development has been aggressively carried forward.

The shaft is 465 feet below the seventeenth, or Roosevelt tunnel, level and stations, pump sumps, and two ore pockets, each of 150 tons capacity, are completed on the eighteenth, nineteenth, and twentieth levels.

The program of the last two years of replacement of obsolete with steel structures is now almost complete. Mining operations show increased cost of 39.8 cents per ton, largely due to increased broken ore reserve, shaft sinking, and other development expenditures.

The following is a summary of the company's operations for the year ended August 31, 1924:

	Feet
Drifts and crosscuts	3,810
Raises and winzes	1,168
Diamond-drill hole	228
Shaft sunk	255

An unusually large amount of work has been done in exploring new ground on upper levels in addition to sinking the shaft to 465 feet below the Roosevelt tunnel level. This is 286 feet deeper than of August 31, 1923, and on date of issue of this report stations are cut on eighteenth, nineteenth, and twentieth levels. On eighteenth a pump station with five pumps has been completed, stopes cut out and operating. On twentieth a pump station is being cut out for three 700-gallon pumps. Pockets for handling ore are installed in all these levels. The present amount of water pumped is 1,400 gallons per minute.

Between the ninth and eighth levels a promising stope of $35 ore is being broken, and a parallel vein showing good values in two crosscuts is also being developed.

On both twelfth and thirteenth ore is being broken in goodsized stopes.

On the seventeenth level in the main stopes ore is still being broken. On this level a very promising stope is being developed with values of very high grade.

On the eighteenth level a stope of about the contour of the ore shown on the seventeenth level is being broken; also the smaller shoot of ore on the funeral dyke has been opened up for stoping.

During the year the ore house and terminal bins have been rebuilt, the coal tram completed, and a larger change room and transformer house are about completed.

A diamond-drill hole, 3 inches in diameter, to carry the power cable for pumps, is now 135 feet below the fourth level. On account of danger of wrecks in the shaft it was decided to install a double transmission line.

Production of the Cresson mine, 1903 to December 31, 1924

Period	Dry short tons	Gross value	Freight and treatment, including war tax	Net value	Average gross value per ton	Average net value per ton	Dividends
1903 to Aug. 31, 1924	1,225,714	$25,124,523	$6,969,069	$18,155,454	$20.49	$14.81	----------
Sept. 1, 1923, to Aug. 31, 1924 (company ore)	123,205	2,001,458	686,586	1,314,872	16.24	10.67	$488,000
Sept. 1, 1923, to Aug. 31, 1924 (lessees' ore)	65	374	254	120	5.75	1.84	
1903 to Dec. 31, 1924	----------	25,965,882	----------	----------	----------	----------	10,410,273

On Beacon Hill small shipments were made from the El Paso and Gold Dollar mines.

On Bull Hill the producing mines were the Blue Bird (Buckeye Co.), Dexter Dump, Gold Sovereign, Stratton Estate (from the dumps only of the American Eagles, Orpha May, and others), and Wild Horse. The long idle American Eagles shaft was reopened, repaired, and sunk 500 feet deeper—from 1,500 to 2,000 feet.

Producing mines between Altman and Goldfield were the Bison, Pinto, Pueblo No. 2 (Free Coinage Co.), Deadwood (United Gold Mines Co.), Empire Lee, Victor, and Vindicator-Theresa.

On Battle Mountain the producing mines were the Ajax, Requa, Big Banta, Bonanza, Granite, Portland-Independence group, New Market, Rose Nicol, and Strong.

The annual report of the Portland Gold Mining Co. for 1924 says:

As stated in the report to the stockholders under date of July 16, 1924, the net earnings of your company during the first half of the year were most satisfactory, making possible the payment of the entire indebtedness of the company besides leaving a cash balance on hand of $60,245.

Unfortunately, the net results of operations during the last half of the year fell far short of our expectations, the value of the gold produced during that period having been less than the cost of production, of sinking the shaft, and of the development work being carried on.

At this date, February 10, 1925, the station at the 3,000-foot level has been completed and is ready for the installation of the pumps, and within the next month or two connection should be made with the main vein which is so very rich at the bottom of the 2,700-foot level.

The production from the mine was as follows:

	Dry tons	Gross value	Average value
Company ore to Golden Cycle	11,947	$412,954	$34.57
Lessees' ore to Golden Cycle and Independence	10,879	256,361	23.56
Estimated tonnage shipped to Independence mill	164,574	792,429	4.81
High grade treated at the mill	7	28,716	4,102.29
	187,407	1,490,460	7.96

The results of our operation during the first half of the year were highly gratifying, the net earnings being the largest in the last five years, although the gross production was below the average for that period. However, the twenty-seventh level, which furnished a large part of the shipping ore mined on company account during the year, failed to come up to our expectations, not only in tonnage but also in average grade, for the high grade on this level extended only about 30 feet above the level. As on the twenty-sixth level, very little ore has been found on the twenty-seventh level in the territory south of the shaft. In this section the ore in the small stopes opened on the twenty-sixth level extended only a short distance below that level. Recently, in raising from the twenty-seventh level we have opened some granite ore of lower grade but otherwise similar to that found in this section of the mine above the 2,450-foot level. This is the only encouraging development in the south end of the property in the last 350 feet.

The 2,700-foot level north developed as many surprises as the 2,600-foot level. The series of cross veins found on the 2,600-foot level and known as the north Nos. 1, 2, 3, 4, and 5 decreased in both size and value below the 2,600-foot level and gradually drew so closely together that we have mined them all in one stope, which is about 100 feet long. This stope is about 40 feet wide on the bottom and in excess of 60 feet at the top. It has broken through to the 2,600-foot level and should furnish a large tonnage of excellent grade of mill dirt.

North No. 1 vein on the 2,700-foot level is a heretofore unknown vein which furnished the greater part of the shipping ore from that level. When fully developed it proved to be 225 feet long and on the level varied from 8 to 14 feet in width. North No. 2 vein, although not so large and rich, was also new on that

level. The main No. 1 or contact vein likewise showed excellent ore on the level and has been stoped for a length of approximately 250 feet. Stoping on all of these veins was disappointing during the last half of the year for in every case the grade decreased as we went up. North No. 2 vein did not persist more than 80 feet above the level. North No. 1 vein began to decrease in size and value some 30 feet above the level. The result has been that while the results for the year have been extremely satisfactory they nevertheless have fallen off from what we anticipated.

For several months we have drifted south on the 2,100-foot level following the contact into the Independence ground. The breast of this drift is in now some 200 feet into the Independence territory and has not yet disclosed any values. We plan to crosscut the various veins in this section after we have reached a point opposite the Independence shaft.

The mill was operated on one shift until August 18, at which time we completed the work of electrifying the Independence hoist and erection of new screening equipment at the Independence shaft. Since then we have operated on two shifts, treating approximately 650 tons per day.

The electrification of the Independence hoist has been a complete success, and we have hoisted approximately 1,000 tons daily there during the past few months. This material, which is being drawn from the caved areas in the Portland and Independence mines, is passed over the grizzlies. About 65 per cent is rejected and the balance goes to the mill.

Our cost on this operation is very low, averaging less than 95 cents for each net ton delivered into the mill, the cost per ton of the crude ore hoisted being 31.2 cents.

During the year we have made many needed improvements to the mine and mill buildings, all of which have now been painted and repaired. Both mine and mill plants are now well equipped for economical and efficient operation.

The third electric compressor has been installed at the mine. The old transformer station at No. 2 shaft, which was endangered by the caving of the ground in this vicinity resulting from the drawing of the mill dirt from the 900-foot level, has been moved into the old boiler house at No. 1 shaft, and a new power line supplying the electric hoist at the Independence has been extended to the No. 2 shaft and makes a shorter and more certain power supply for the pumps.

During the past year the shaft has been sunk to the 3,001-foot level, which is 900 feet below the drainage tunnel. The stations have been cut, and at this time crosscutting is in progress toward the vein system. The crosscuts will be driven simultaneously from the twenty-ninth and thirtieth levels, which are 135 feet apart, and both should cut the vein about the 1st of March.

We have purchased three new Lecourtnay bronze pumps, which will be set on the thirtieth level. This will give us two pumps of 1,000 gallons per minute capacity each and two of 400 gallons per minute each against a 1,000-foot head. No pumps will be set on the 2,900-foot level, but a relief pump capable of handling 1,000 gallons will be left on the 2,700-foot level, and steel water doors set on the twenty-ninth and thirtieth levels. We also plan to install a second power cable to the pumps. The water does not change in volume from level to level. We are pumping approximately the same amount per day that we did five years ago.

The large reserves of mill dirt which have been discussed in many previous reports were depleted only about 100,000 gross tons during the year, the balance of the mill dirt being ore-house reject.

It is impossible to make any definite forecast of the ore conditions which will be found on the new levels. However, we do know that we had better and larger ore on the 2,700-foot level than we had above it. Several dykes have been encountered in cutting the pump station on the 3,000-foot level, proving definitely that the fissuring extends in a marked degree below that point. So it is only fair to assume that ore bodies at least as productive as those found continuously for 2,700 feet above will be found on this level.

Statement of all work in Portland properties to January 1, 1925

	Total during 1924 in feet	Total previous years in feet	Grand total in feet
Drifts	2,215	156,027	158,242
Crosscuts	469	146,565	147,033
Raises	629	31,504	32,133
Winzes	28	6,575	6,604
Shafts	278	13,541	13,819
	3,619	354,212	357,831

Total for Portland mine, 67 miles, 4,072 feet.
Total for Independence mine, 17 miles, 1,918 feet.

The United Gold Mines Co., controlling properties in various parts of the Cripple Creek district, but obtaining its main production from Battle Mountain and between Altman and Goldfield, in its annual report for the year ended December 31, 1924, says:

During 1924 a large amount of work was done on the Vindicator property without any encouraging developments. It was decided to stop company work and cut expenses to a minimum. This has been done to a great extent, and the result is most encouraging as is shown by a small profit for the months of January and February, 1925.

Through the Rose Nicol shaft much more work was done than is indicated by the number of feet of drifting shown in statement. A large stope of ore running from $5 to $6 per ton was opened on the tenth level, 1,250 feet from the surface. We have stoped from this level to about 35 feet above the eighth level, where the grade of ore became unprofitable. There is a large reserve broken in this stope. Several other stopes have been opened and are worked as filled stopes.

The small ore shoot in the Big Banta claim has made a limited though steady production and at this time is of better grade and larger. Work is being started on the downward continuation of the Trail ore which was formerly worked through the Dexter shaft.

As the Rose Nicol shaft is only equipped with a bucket, the production made by Superintendent Anderson is remarkable.

The ore on the New Market claim was abandoned by the Tonopah-Ajax Co., after working out the better grades, and the Ajax shaft was closed down. There is a large tonnage of low-grade ore that can some day be mined from this claim. The Bonanza claim has ore developed that can be worked when the Granite Co. is able to hoist the production.

There are several small leases on which valuable development work is being done. The crusher plant is in excellent condition, with a good market for its output.

The company is in position with a little favorable development to make a much better showing in 1925.

Total production of United Gold Mines

	Net tons	Gross value
Ore mined before consolidation	26,310.038	$456,806.19
Produced under United Gold Mines Co	388,945.588	6,257,137.03
	415,255.626	6,713,943.22

Production of the United Gold Mines for the year 1924

Group	Dry tons	Gross value	Royalties	Company ore	Lessees	Average per ton
Bonanza	26. 257	$656. 43	$103. 19		$363. 98	$25. 00
Deadwood	804. 010	15, 641. 04	2, 163. 87		8, 108. 0[illegible]	19. 45
Hardwood	54. 084	2, 609. 85	630. 54		1, 462. 93	48. 25
New Market	18, 772. 612	278, 780. 18	28, 333. 25		154, 983. 41	14. 85
Requa	20, 106. 352	193, 798. 87	116. 10	$113, 889. 89	329. 48	9. 64
Theresa	3, 050. 505	30, 674. 65	7, 853. 22	2, 841. 96	7, 397. 83	10. 06
Vindicator	31, 189. 345	217, 573. 68	47, 874. 06	9, 806. 77	49, 149. 97	6. 98
Wild Horse	1, 316. 300	33, 868. 28	5, 316. 88		18, 275. 05	25. 73
W. P. H	168. 079	2, 205. 07	207. 36		957. 30	13. 11
	75, 487. 544	775, 808. 05	92, 598. 47	126, 538. 62	241, 027. 99	10. 28

Development for the year 1924

	Feet
Deadwood group: Deadwood Leasing Co	20
Hardwood group: Dworak & Kellum	150
Requa group:	
Company-Big Banta	894
James & Co	8
Vindicator group:	
Lessees	5, 644
Company	1, 963
Wild Horse group:	
Cain & Co	489
W. P. H.-A. J. Campbell	120
Rose Nicol lease:	
Sublessees	173
Company	490
	9, 951

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Charles W. Henderson

PRODUCTION

The total calculated gross value of the gold, silver, copper, lead, and zinc from ore and gravel produced in New Mexico in 1924 amounted to $12,470,119, as compared with $11,573,805 in 1923—an increase of $896,314, or nearly 8 per cent. There were 96 producing mines, of which 86 were deep mines and 10 were placers—a decrease of 18 deep mines and 6 placers.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1923–24

Year	Ore	Gold [a]	Silver [a]	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1923	3,111,050	$551,713	747,127	61,356,802	3,832,427	16,496,000	$11,573,805
1924	3,040,652	512,735	795,070	74,691,436	3,634,511	20,759,200	12,470,119
Increase or decrease from 1923	−70,398	−38,978	+47,943	+13,334,634	−197,916	+4,263,200	+896,314

[a] Includes placer production.

ORE

The quantity of ore sold or treated in 1924 in New Mexico was 3,040,652 short tons, a decrease of 2 per cent from 1923. Copper ore amounted to 2,832,901 tons, zinc ore 115,045 tons, dry silver ore 72,780 tons, and the remainder was lead ore, lead-zinc ore, dry gold and silver ore, dry gold ore, and a small amount of copper-lead ore. Amalgamation of 1,100 tons of dry gold ore and cyanidation of 72,736 tons of dry silver ore, followed by concentration on tables, yielded an average in bullion and concentrates of 0.157 ounce of gold and 8.372 ounces of silver to the ton.

GOLD

The mine production of gold in New Mexico in 1924 amounted to 24,803.56 fine ounces, valued at $512,735. Catron County produced 45 per cent of the total, Hidalgo 37.5 per cent, Grant 14.7 per cent, and Lincoln 1.5 per cent. Dry and siliceous ore yielded 47.9 per cent.

[1] For descriptions of geology and of mines see Lindgren, Waldemar, Graton, L. C., and Gordon, C. H., The Ore Deposits of New Mexico: U. S. Geol. Survey Prof. Paper 68, 1910; also Finlay, J. R., Report of Appraisal of Mining Properties of New Mexico to Tax Commissioners, Sante Fe, N. Mex., 1921–22. Comparative statistics for the years 1904 to 1922 have been published in Mineral Resources for 1922.

SILVER

The mine production of silver in New Mexico in 1924 amounted to 795,070 fine ounces, valued at $532,697, as compared with 747,127 fine ounces, valued at $612,644, in 1923. Catron County produced 77.7 per cent of the total, all from the siliceous ore of the Mogollon district; Hidalgo County 14.6 per cent, chiefly from the Lordsburg district; Grant County 5.4 per cent, chiefly from the Central district; and Socorro County 1.3 per cent, chiefly from the Magdalena district. Placer mines yielded 27 ounces of silver in 1924.

Dry and siliceous silver ore yielded 77.8 per cent of the total, chiefly from Catron County, with very small quantities from Sierra and Grant Counties; copper ore yielded 16.6 per cent, chiefly from Hidalgo, Grant, and Socorro Counties; lead ore yielded 4.2 per cent, chiefly from Grant, Socorro, Hidalgo, and Luna Counties; and copper-lead ore yielded 0.5 per cent, all from Grant and Lincoln Counties.

COPPER

The mine production of copper in New Mexico in 1924 amounted to 74,691,436 pounds, valued at $9,784,578. Of this total 99.6 per cent was produced from Grant and Hidalgo Counties, chiefly from the Chino Copper Co.'s operations in the Central district and from the Eighty-Five mine in the Lordsburg district. Copper ore yielded 99.7 per cent of the total.

LEAD

The mine production of lead in New Mexico in 1924 amounted to 3,634,511 pounds, valued at $290,761. The chief lead-producing districts were the Magdalena district, Socorro County; Central and Pinos Altos districts, Grant County; Cooks Peak, Luna County; and Red Hill district, Hidalgo County.

ZINC

The mine production of zinc in New Mexico in 1924 amounted to 20,759,200 pounds, valued at $1,349,348. The chief zinc-producing districts were the Central (Hanover), in Grant County, and the Magdalena (Kelly), in Socorro County.

OUTPUT OF ORE AND RECOVERED METAL CONTENT

Ore and metals produced in New Mexico in 1924, by sources

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	1,203	495.17	443	1,700		
Dry gold and silver ore	2,193	204.79	7,300	81,266		
Dry silver ore	72,780	11,172.69	618,329	966	1,682	
	76,176	11,872.65	626,072	83,932	1,682	
Copper ore	2,832,901	12,625.60	131,743	74,494,746		
Copper-lead ore	507	15.23	3,995	39,713	130,659	
Lead ore	8,017	114.04	33,233	73,045	2,524,195	
Lead-zinc ore	8,006				969,491	3,724,700
Zinc ore	115,045				8,484	17,034,500
	2,964,476	12,754.87	168,971	74,607,504	3,632,829	20,759,200
Total deep mines	3,040,652	24,627.52	795,043	74,691,436	3,634,511	20,759,200
Total placers		176.04	27			
	3,040,652	24,803.56	795,070	74,691,436	3,634,511	20,759,200

Ore sold or treated in New Mexico in 1924, by counties, with content in terms of recovered metals

Dry and siliceous gold and silver ore

County	Ore	Gold	Silver	Copper	Lead
GOLD ORE	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Colfax		11.70			
Grant	198	95.85	374	1,483	
Lincoln	1,000	374.33	33		
Sierra	5	13.29	36	217	
	1,203	495.17	443	1,700	
GOLD AND SILVER ORE					
Grant	41	5.29	212	1,787	
Hidalgo	2,152	199.50	7,088	79,479	
	2,193	204.79	7,300	81,266	
SILVER ORE					
Catron	72,736	11,172.69	618,094		
Grant	25		60		
Sierra	19		175	966	1,682
	72,780	11,172.69	618,329	966	1,682
	76,176	11,872.65	626,072	83,932	1,682

Copper ore

Dona Ana	45		164	8,893	
Grant	2,745,170	3,423.78	20,704	69,411,213	
Hidalgo	86,211	9,065.82	105,422	4,845,919	
Santa Fe	534	123.50	1,788	143,152	
Sierra	11	12.10	739	2,604	
Socorro	930	.40	2,926	82,965	
	2,832,901	12,625.60	131,743	74,494,746	

Copper-lead ore

Grant	386	15.23	3,586	31,117	103,747
Lincoln	121		409	8,596	26,912
	507	15.23	3,995	39,713	130,659

Lead ore

Dona Ana	10		136		2,064
Grant	3,643	60.40	18,116	52,484	1,198,065
Hidalgo	718	33.52	3,496	4,281	220,726
Luna	1,161	9.77	3,024	573	306,198
Otero	499	1.02	397	4,046	129,286
Sierra	7	.10	347		3,219
Socorro	1,979	9.23	7,717	11,661	664,637
	8,017	114.04	33,233	73,045	2,524,195

Ore sold or treated in New Mexico in 1924, by counties, with content in terms of recovered metals—Continued

Lead-zinc ore

County	Ore	Lead	Zinc
	Short tons	*Pounds*	*Pounds*
Santa Fe	35	5,787	14,400
Socorro	7,971	963,704	3,710,300
	8,006	969,491	3,724,700

Zinc ore

Grant	114,797		16,921,000
Socorro	248	8,484	113,500
	115,045	8,484	17,034,500

PLACER OUTPUT

Placer output of gold and silver in New Mexico in 1924

County	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
Colfax	111.41	$2,303	15	$10	$2,313
Grant	50.41	1,042	12	8	1,050
Santa Fe	14.22	294			294
	176.04	3,639	27	18	3,657
Decrease from 1923	28.01	579	3	6	585

SMELTERS

The only smelting plant in the State—the zinc oxide plant at Waldo, near Cerrillos—was idle in 1924. Ore from New Mexico went to the lead and copper plants of the El Paso Smelting Works, at El Paso, Tex.; the Copper Queen copper smelter and the Calumet and Arizona copper smelter, at Douglas, Ariz.; the Ozark zinc-lead oxide plant, at Coffeyville, Kans.; and the Empire Zinc Co.'s zinc oxide plant, at Canon City, Colo. Small shipments of zinc ore were made to Collinsville, Okla., and Mineral Point, Wis., and of lead ore to the Eagle Picher Lead Co.'s smelter, at Galena, Kans.

MINING INDUSTRY

The features of metal production in New Mexico in 1924 were: A 22 per cent increase in copper production, represented by the increased output of the Chino mines at Santa Rita and of the mines at Lordsburg; an increase in quantity of silver produced (despite the lower average price received), represented by the increased output at Mogollon, which was large enough to overcome the decrease in Grant, Hidalgo, and Sierra Counties; the decrease in gold production in the Baldy, Lordsburg, and Pinos Altos districts, and the increased production in the Mogollon district; only a slight decrease in lead production; and a notable increase in zinc production in both the Hanover and Magdalena districts.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1924, by counties

County	Number of producing mines	Ore (short tons)	Metal content [a]			
			Gold [b]		Silver [b]	
			Fine ounces	Value	Fine ounces	Value
Catron	5	72,736	11,172.69	$230,960	618,094	$414,123
Colfax	6		123.11	2,545	15	10
Dona Ana	1	55			300	201
Grant	38	2,864,260	3,650.96	75,472	43,064	28,853
Hidalgo	15	89,081	9,298.84	192,224	116,006	77,724
Lincoln	2	1,121	374.33	7,738	442	296
Luna	10	1,161	9.77	202	3,024	2,026
Otero	2	499	1.02	21	397	266
Santa Fe	5	569	137.72	2,847	1,788	1,198
Sierra	6	42	25.49	527	1,297	869
Socorro	6	11,128	9.63	199	10,643	7,131
	96	3,040,652	24,803.56	512,735	795,070	532,697
Total, 1923	120	3,111,050	26,689.12	551,713	747,127	612,644
Increase or decrease from 1923	−24	−70,398	−1,885.56	−38,978	+47,943	−79,947

County	Metal content [a]						Total value
	Copper		Lead		Zinc		
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron							$645,083
Colfax							2,555
Dona Ana	8,893	$1,165	2,064	$165			1,531
Grant	69,498,084	9,104,249	1,301,812	104,145	16,921,000	$1,099,865	10,412,584
Hidalgo	4,929,679	645,788	220,726	17,658			933,394
Lincoln	8,596	1,126	26,912	2,153			11,313
Luna	573	75	306,198	24,496			26,799
Otero	4,046	530	129,286	10,343			11,160
Santa Fe	143,152	18,753	5,787	463	14,400	936	24,197
Sierra	3,787	496	4,901	392			2,284
Socorro	94,626	12,396	1,636,825	130,946	3,823,800	248,547	399,219
	74,691,436	9,784,578	3,634,511	290,761	20,759,200	1,349,348	12,470,119
Total, 1923	61,356,802	9,019,450	3,832,427	268,270	16,496,000	1,121,728	11,573,805
Increase or decrease from 1923	+13,334,634	+765,128	−197,916	+22,491	+4,263,200	+227,620	+896,314

[a] In terms of metal recovered; figures are derived from individual mine reports, with allowances made for smelting recoveries and losses.
[b] Includes placer production.

Gold and silver contained in bullion produced at mills in New Mexico in 1924

Process	Ore	Gold	Silver	Quicksilver used	Sodium cyanide used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	1,100	425.18	69	250	
Cyanidation	72,736	10,029.56	566,790		[a] 112,500
	73,836	10,454.74	566,859	250	112,500

[a] In terms of 97 per cent strength.

Mine production of metals from gold and silver mills in New Mexico in 1924, by counties

County	Ore to gold and silver mills	Recovered in bullion		Concentrates and recovered content		
		Gold	Silver	Concentrates produced	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*
Catron	72,736	10,029.56	566,790	39	1,143.13	51,304
Colfax		11.70				
Grant	100	39.15	36			
Lincoln	1,000	374.33	33			
	73,836	10,454.74	566,859	39	1,143.13	51,304

NOTE: Average recovery per ton in bullion and concentrates: Gold, 0.157 ounce; silver, 8.372 ounces.

Mine production of metals from concentrating mills in New Mexico in 1924

County	Ore to concentrating mills	Concentrates and recovered content				
		Concentrates produced	Gold	Silver	Copper	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Grant	2,820,248	163,970	3,242.16	14,158	66,776,506	16,322,000

Mine production of metals from New Mexico concentrates in 1924, by counties

County	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	39	1,143.13	51,304			
Grant	163,970	3,242.16	14,158	66,776,506		16,322,000
	164,009	4,385.29	65,462	66,776,506		16,322,000
Increase or decrease from 1923	+9,249	−906.26	−39,550	+11,417,607	−915	+3,649,100

Mine production of metals from New Mexico crude ore shipped to smelters in 1924, by counties

County	Ore	Recovered metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dona Ana	55		300	8,893	2,064	
Grant	43,912	319.24	28,858	2,721,578	1,301,812	599,000
Hidalgo	89,081	9,298.84	116,006	4,929,679	220,726	
Lincoln	121		409	8,596	26,912	
Luna	1,161	9.77	3,024	573	306,198	
Otero	499	1.02	397	4,046	129,286	
Santa Fe	569	123.50	1,788	143,152	5,787	14,400
Sierra	42	25.49	1,297	3,787	4,901	
Socorro	11,128	9.63	10,643	94,626	1,636,825	3,823,800
	146,568	9,787.49	162,722	7,914,930	3,634,511	4,437,200

CATRON COUNTY

Mogollon district.—The Mogollon Mines Co. ran its Last Chance 40-stamp, 150-ton cyanidation and concentration mill continuously on ore from its Last Chance-Top mine and from the Confidence group under lease. The Fanney 200-ton cyanidation mill was put in operation by the Mogollon Mines Co. in March, 1924, and treated ores from the Fanney and Alberta groups. Bullion was shipped to the Denver Mint. Concentrates were shipped to El Paso.

Mine production of gold and silver in Mogollon or Cooney district, Catron County, N. Mex., 1923–24

Year	Ore	Gold	Silver	Total value
	Short tons		*Fine ounces*	
1923	47,644	$179,351	398,714	$506,296
1924	72,736	230,960	618,094	645,083
Increase from 1923	25,092	51,609	219,380	138,787

COLFAX COUNTY

Baldy district (*Elizabethtown, Therma, Baldy*).—A small quantity of specimen gold was shipped from the Aztec mine. Producing placers were the Ute Creek, Lowrey, South Ponil, Little Nigger, and small sluicing operations on Willow and Moreno Creeks.

Mine production of gold, silver, and copper in Elizabethtown district, Colfax County, N. Mex., 1923–24

Year	Ore	Gold		Silver [a]	Copper	Total value
		Placer	Deep			
	Short tons			*Fine ounces*	*Pounds*	
1923	2,315	$1,811	$48,725	430	592	$50,975
1924		2,303	242	15		2,555
Increase or decrease from 1923	−2,315	+492	−48,483	−415	−592	−48,420

[a] Includes placer production.

DONA ANA COUNTY

A car of copper sulphide and a small lot of lead sulphide ore were shipped from the Memphis mine, in the Organ Mountains district.

GRANT COUNTY [2]

Burro Mountain district.—At the Burro Mountain branch of the Phelps Dodge Corporation, at Tyrone, cement copper was produced by leaching old dumps. Lessees of surface croppings of this property shipped several thousand tons of oxidized copper ore.

Central district.—At the Hurley mill of the Chino mines (at Santa Rita) of the Ray Consolidated Copper Co., the remodeling begun in 1923 was virtually completed in 1924. Only five sections of the mill and the regrinding part of a sixth section were in operation throughout the year. The general manager of the Chino mines made

[2] For a description of the geology of Bear Mountain, Burro Mountain, Chloride Flat, Fierro, Fleming, Georgetown, Hanover, Lone Mountain, Pinos Altos, and Santa Rita, see Paige, Sidney, Silver City, N. Mex.: U. S. Geol. Survey Geol. Atlas, Folio 199, 1916.

the following general statement of operations of the Chino mines and mills for the calendar year ended December 31, 1924:

There were at the close of the year 216 mining claims, comprising a total area of 3,625 acres. Of this total 3,151 acres are covered by 183 patented mining claims, the remaining 474 acres are covered by 32 unpatented filings. In addition to the foregoing patented and unpatented mining claims, the company owns 120 acres of agricultural lands adjacent to its group of mineral holdings, making a total of 3,745 acres owned and controlled by the company in the Santa Rita mining district, Grant County, N. Mex.

The company owns a total area of 19,891 acres of nonmineral land in connection with its milling operations at Hurley, its various water supplies, and for disposal of tailings. In connection with its operations, therefore, the company owns 3,625 acres of mineral land and 20,011 acres of agricultural and grazing lands, making a total of 23,636 acres.

A tunnel, known as Hearst Tunnel No. 3, was started during March at the south side of the Hearst ore body for the purpose of developing the extent of the ore as exposed on the slopes. This and two crosscuts, making a total of 1,248 feet driven, were continued throughout the year. A good grade of ore was developed and the extent of it partially outlined.

Sufficient prospect drilling was done on the northerly side and in the bottom of the Whim Hill ore body to definitely determine its extent.

Prospect drilling was started during the latter part of the year to determine a possible location for a shaft to serve the underground Estrella ore body. Although these holes were located some 500 feet northwesterly from the developed ore body, sufficient ore was encountered in each hole drilled to confirm important increases in the extent of this ore body. Diamond drilling, which continued throughout the year, developed ore which shows a possible connection between the Estrella and Sierra ore bodies at the western extremities. Further prospecting by diamond drilling was discontinued, as the character of the rock will not permit of economical drilling of deep holes with such equipment.

There remained at the close of the calendar and fiscal year unmined and fully developed ore amounting to 95,299,298 tons of an average grade of 1.528 per cent copper, and in addition to the unmined ore reserves 3,036,558 tons of ore, averaging 1.227 per cent copper, in the stock piles at Santa Rita, and 88,465 tons in a special reserve for experimental purposes, averaging 1.37 per cent copper. The total ore, therefore, unmined and untreated is 98,424,321 tons, of an average grade of 1.526 per cent copper. The total ore calculated as being developed as of January 1, 1921, and fully discussed in the eleventh annual report of the Chino Copper Co., including the ore removed to the close of operations December 31, 1922, was 127,335,159 tons, of an average grade of 1.58 per cent copper. At the close of 1924 a total of 32,035,909 tons of an average grade of 1.733 per cent copper had been mined. Of this amount 28,833,101 tons, averaging 1.78 per cent copper, was shipped to the mill and 77,545 tons, averaging 5.018 per cent copper, was shipped direct to the smelter, the remainder being on the stock pile and experimental reserve at the mine, as previously stated.

Equipment and surface improvements at the mine.—A Marion model No. 350 electric shovel was placed in service the middle of June. Two Marion model No. 92 steam shovels were equipped with tractors. Thirty-five 30-yard dump cars were received about the middle of the year. A type "L" Industrial Works locomotive crane was purchased for handling the heavier locomotives and car equipment. Well drilling continued throughout the year, resulting in an increase in the industrial water supply.

Mining operations.—During the first four months of the year 13 shovel crews operated. These were gradually increased to 16 crews the latter part of August, an equal number working the day and night shifts.

The total ore and waste removed by power shovels was 4,556,329 cubic yards in place. Of this amount 2,770,017 cubic yards was capping, the remainder being equivalent to 3,310,546 tons of ore. Of this ore 2,703,657 tons was sent to the mill, 33,698 tons was shipped direct to the smelter, and 573,191 tons was placed on the stock pile at Santa Rita, which allows for 17,248 tons shipped from stock pile No. 1 to the mill. From the beginning of shovel operations on September 23, 1910, there has been moved a total of 52,157,544 cubic yards of material in place, of which 35,520,197 cubic yards was waste, the remainder being equivalent to 32,026,863 tons of ore. Of this total 28,829,375

tons of ore was shipped to the mill, 72,465 tons went direct to the smelter from the mine, the balance of the ore extracted remaining in stock piles and reserve inventory.

During the year 1924, 1,465 tons of ore was mined from the development tunnels, all of which was shipped to the mill. Since the beginning of operations there has been shipped from underground mining 3,726 tons to the mill and 5,080 tons to the smelter, and in addition there was a total of 240 tons of precipitates shipped to the smelter. Adding the underground ore to the total steam shovel ore moved there has been shipped to the mill, smelter, or remaining in the reserve piles at the mine a total of 32,035,909 tons.

Of the ore shipped to the mill during the period under discussion 5.34 per cent was from the "Northwest" ore body, 64.31 per cent from the "North" ore body, 20.19 per cent from the "South" ore body, and 10.16 per cent from the "Southwest" ore body.

The average cost of shovel operations, including removal of both ore and capping, was 62.80 cents per cubic yard of material in place, as compared with 61.45 cents for the period of 1923. These costs are exclusive of plant depreciation, but include labor, supplies, and general administration expenses, as well as State and county taxes. The increased cost of one and thirty-five hundredths cents per cubic yard was due to moving a greater percentage of the very hard and difficult capping over the "Southwest" ore body.

Construction and improvements at the mill.—The remodeling started the previous year in the fine crushing, gravity concentrating, flotation, and dewatering departments was practically completed, and consisted of the installation of 15-foot bowl classifiers on sections 3, 4, 5, and 7; the installation of additional Garfield and Wilfley tables on sections 3 and 7, with necessary pumping equipment for the proper handling and distribution of the ore in process; the installation of cleaner and recleaner cells on sections 3, 4, and 5 of flotation department, and the partial installation of two Oliver filters in the dewatering department.

For additional and reserve water supply drilling was continued in No. 5 well at Apache until the first part of September, when, at a depth of 2,445 feet, the sandstones were pierced and the granites reached. This developed a reserve of approximately 1,200 gallons per minute from the lower water-bearing strata entirely independent of the upper supply.

The changes in the water recovery pipe lines and repumping stations were completed in June.

In order to obtain full capacity and efficiency from the existing power-station equipment, all boilers were equipped with purifiers, and a 12,000-gallon per minute water-cooling spray pond, with necessary circulating pipe lines and pumps, was constructed.

Mill operations.—Five sections of the Hurley mill, with the regrinding portion of a sixth section, were in operation throughout the year.

There was a total of 2,706,200 dry tons of ore treated, equivalent to an average of 7,394 tons per day, as compared to 7,632 tons per day for the operating period of 1923.

The average copper content of the ore treated during the year was 1.59 per cent copper, approximately 0.09 per cent higher than for 1923.

The total production of concentrates was 141,579 dry tons, averaging 23.68 per cent copper, corresponding to a recovery of 24.78 pounds per ton. This is equivalent to an extraction of 77.83 per cent. Due to mechanical and other improvements made during the year and a change in flotation reagents during October, extraction gradually increased from 72.63 per cent for the first quarter to 83.02 per cent for the fourth quarter.

The average cost of milling was 97.05 cents per ton, as compared with 94.48 cents for the year 1923. The increase occurred in the first half of the year and was due to interference in operation through the reconstruction previously mentioned in the various departments.

The production of copper as contained in the concentrates was 67,053,634 pounds, as compared to 55,391,880 pounds during the year 1923. In addition to the copper from mill operations, precipitates and ore were shipped direct from the mine to the smelter, bringing the total production of copper up to 69,286,108 pounds, which, after allowing for smelter deduction, made the net output of refined copper 66,574,486 pounds.

The expenditures at the mine for larger and improved equipment effected a marked decrease in mining costs in the latter part of the year and permitted the more rapid removal of capping from the Sierra ore body. The performance

of the large revolving-type electric shovel surpassed all expectations in ease of operation and cost of moving material.

The 250-ton magnetic separating mill of the Hanover mine of the Empire Zinc Co. was in continuous operation, producing a zinc concentrate that was shipped to the Empire Zinc Co.'s zinc oxide plant at Canon City, Colo. Copper ore was shipped from the Blue Bell, Dewey-Schley, Groundhog, Jim Fair-Union Hill, Hugo, John Perry, and Lucky Bill. Lead ore was shipped from the Groundhog and Lucky Bill and lead-copper ore from the San Jose mine.

Mine production of gold, silver, copper, lead, and zinc in Central district, Grant County, N. Mex., 1923–24

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1923	2,885,711	$68,108	29,264	54,374,770	1,311,141	13,017,000	$9,062,131
1924	2,859,688	71,121	38,200	66,824,015	1,183,626	16,921,000	10,015,216
Increase or decrease from 1923	−26,023	+3,013	+8,936	+12,449,245	−127,515	+3,904,000	+983,085

Chloride Flat district.—A large quantity of iron-manganese ore was shipped from the Clan-Seven Sisters claims, near Silver City, to the Colorado Fuel & Iron Co.'s steel mill at Pueblo, Colo. No silver ores were mined in the Chloride Flat district in 1924.

Eureka district (in Grant County).—A car each of lead-silver ore was shipped from the American group and the Chappo group, near Hachita. A car of arsenic ore, carrying some silver, was shipped from the Miss Pickle claim, 8 miles west of Hachita, to the Chipman Chemical Co.'s plant, near San Francisco, Calif. (See also Hidalgo County.)

Gold Hill district.—Gold ore from the Cline or Roosevelt mine was amalgamated in a small mill on the property. A car of lead-silver ore was shipped from the Good Luck mine.

Pinos Altos district.—The production of both deep and placer mines in the Pinos Altos district decreased in 1924. Lead ore was shipped from the Calumet, George Schafer group, and Lead Hill claim. Several cars of dry gold ore were shipped from the Langston mine. Placer mines produced 50.41 fine ounces of gold and 12 fine ounces of silver.

Mine production of gold, silver, copper, lead, and zinc in Pinos Altos district, Grant County, N. Mex., 1923–24

Year	Ore	Gold		Silver [a]	Copper	Lead	Zinc	Total value
		Placer	Deep					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1923	2,968	$1,300	$12,988	17,404	68,129	90,471	44,000	$47,899
1924	387	1,042	2,164	1,979	4,320	62,135		10,069
Decrease from 1923	2,581	258	10,824	15,425	63,809	28,336	44,000	37,830

[a] Includes placer production

Swartz district (or Carpenter).—A car of lead-copper sulphide ore was shipped from the Hillside group.

White Signal district.—A car of lead-copper ore from the California group and a car of lead ore from the Lucky Seven-Dandy group was shipped from the White Signal district.

HIDALGO COUNTY

Fremont district.—Several cars of lead-silver ore were shipped from the Volney group.

Gillespie district (Red Hill).—Several cars of lead-silver ore were shipped from the Red Hill group.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—The quantity of highly siliceous gold-silver-copper ore shipped to the copper smelters at Douglas, Ariz., and El Paso, Tex., was slightly less than in 1923. A large quantity of this ore was shipped from the Eighty-Five mine to the Calumet and Arizona smelter. Similar ore was shipped from the Atwood group to El Paso and to the Copper Queen smelter, Douglas, Ariz. Lessees on the Bonney mine shipped similar ore to El Paso. Lead ore was shipped from the Anita and Ruth groups.

Mine production of gold, silver, copper, and lead in Lordsburg district, Hidalgo County, N. Mex., 1923–24

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1923	96,587	$216,554	141,538	4,314,122	46,185	$970,024
1924	88,472	192,203	113,591	4,927,878	40,412	917,094
Increase or decrease from 1923	−8,115	−24,351	−27,947	+613,756	−5,773	−52,930

Steins district.—Several cars of lead ore were shipped from the Carbon Hill mines.

LINCOLN COUNTY

Red Cloud (Gallinas Mountains) district.—Seven cars of lead-copper ore were shipped from the Deadwood-Red Cloud mine.

Whiteoaks district.—The Homestake amalgamation mill was operated for a short period in 1924.

LUNA COUNTY

Cooks Peak district.—Several hundred tons of lead-silver ore was shipped from the Desdemona, Inez, Graphic, and Sycamore mines.

Fremont district.—Several cars of lead-silver ore were shipped from the Keno and the Rattlesnake mines.

Victorio district.—Several hundred tons of lead-silver ore was shipped from the Rambler, Owl, Wildcat, and Helen and Jessie mines.

OTERO COUNTY

Orogrande district.—Several cars of lead-silver ore were shipped from the Orogrande district in 1924.

Sacramento Mountains district (*Alamogordo*).—Several hundred tons of lead ore containing only traces of silver was shipped from the Alamo group.

SAN MIGUEL COUNTY

No new development work was done at the Pecos mine (also known as the Hamilton and as the Cowles), in the Canyon of the Pecos River at the junction of Willow Creek, 13 miles north of the town of Pecos and 17 miles east-northeast of Santa Fe. This mine has large reserves of copper-lead-zinc-silver-gold ore.

SANTA FE COUNTY

New Placers district (*Golden*).—Mexicans recovered 14.22 fine ounces of placer gold from small sluicing operations.

At the Amazon-Anaconda-Lincoln-Lucky group of the Collier Mines Co., opened by a 3,000-foot adit and four shafts, one of the shafts was sunk from 400 feet in depth to 525 feet, and 210 feet of crosscut was driven. One car of lead-zinc ore was shipped. Several hundred tons of copper-silver-gold ore was shipped by lessees from the San Pedro copper mine.

SIERRA COUNTY

Mine production of gold, silver, copper, and lead in Sierra County, N. Mex., 1923–24

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1923	6,441	$6,443	80,814	61,469	12,842	$82,645
1924	42	527	1,297	3,787	4,901	2,284
Decrease from 1923	6,399	5,916	79,517	57,682	7,941	80,361

Only a few small lots of ore were shipped from mines in the various districts in Sierra County; the chief shipments were a half car of dry silver ore from the Black Knife group, in the Chloride district, and a 5-ton lot of gold ore from the Lady Franklin group, in the Kingston district.

SOCORRO COUNTY

Magdalena district (*Kelly*).—Lessees on the Graphic-Waldo claims of the Ozark Smelting & Refining Co. shipped several thousand tons of zinc-lead sulphide ore, several hundred tons of zinc-lead oxidized ore, and several hundred tons of lead oxidized ore. A lessee on the Nitt claim shipped about 1,000 tons of copper ore, and several hundred tons of zinc sulphide ore. A lessee on the Kelly mine shipped several hundred tons of lead-silver oxidized ore. Several hundred tons of lead ore was shipped from the Juanita mine.

GOLD, SILVER, COPPER, AND LEAD IN TEXAS

(MINE REPORT)

By Charles W. Henderson

Mine production of gold, silver, copper, and lead in Texas, 1923–24

Year	Ore (short tons)	Recovered metal content							Total value
		Gold	Silver		Copper		Lead		
			Fine ounces	Value	Pounds	Value	Pounds	Value	
1923	78,610	$802	811,824	$665,696	4,257	$625	26,605	$1,862	$668,985
1924	84,744		720,739	482,895					482,895
Increase or decrease from 1923	+6,134	−802	−91,085	−182,801	−4,257	−625	−26,605	−1,862	−186,090

Presidio County.—The Presidio Mining Co., since 1884, has been mining silver ore from replacement deposits of limestone at the Presidio mine in the Shafter district. The property is equipped with a 225-ton cyanidation mill; crushing is done with 3 Sturtevant crushers and 15 stamps (1,100 pounds each), and is followed by fine grinding in two 4½-foot by 18-foot tube mills, classifying, agitating in cyanide solution, filtering, and precipitating by zinc in Merrill-Crowe presses. This mine has produced the larger part of the silver output of Texas which, from 1885 to 1924, amounted to 17,988,043 ounces, having a commercial value of $13,235,470.

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